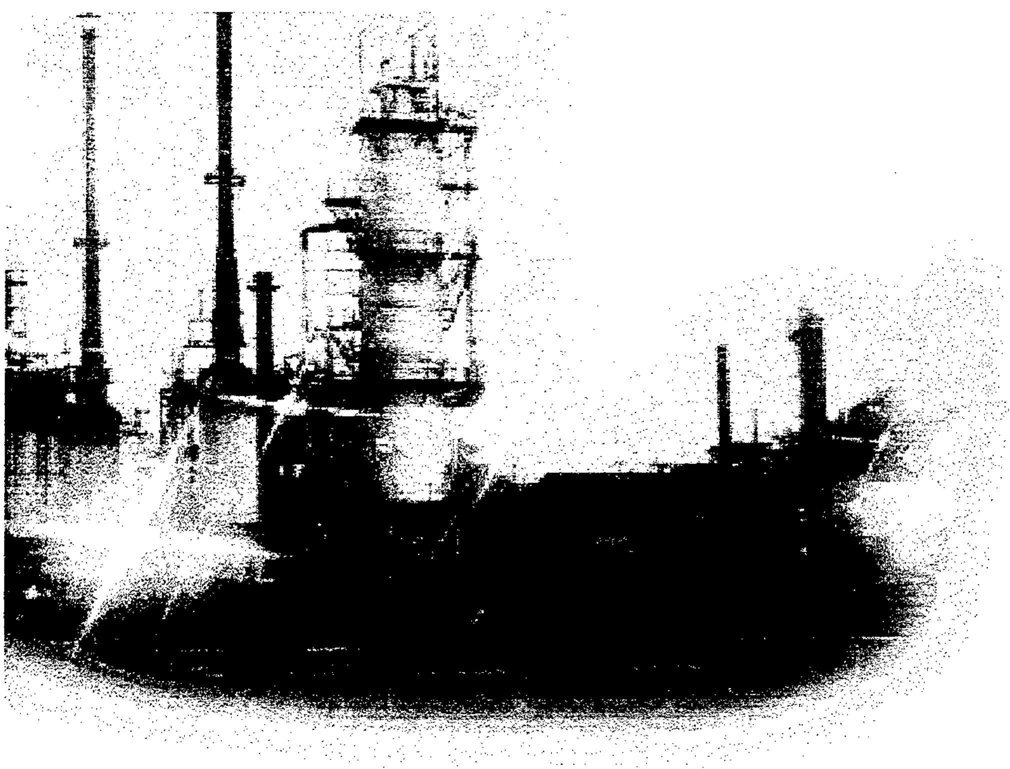
Crude Oil Price Modeling ... A Macro-Economic Approach



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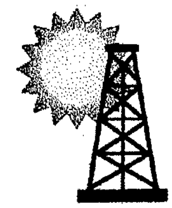


Objective

Examine quantitative and qualitative factors and their correlation to crude oil prices.

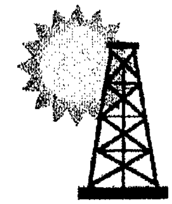
Part I: This thesis is **Part-I** of a two-part evaluation concerning crude oil price prediction and modeling. In **Part I**, quantitative factors which are suspected to influence crude oil price will be examined by statistically comparing their effects on crude oil price over time. This will be done on an individual factor basis as well as using multiple regression analysis. Additionally, qualitative factors which are suspected of influencing crude oil prices will be evaluated through historical observation and an application of logical reasoning and analysis. All factors, quantitative and qualitative, which are identified as possessing some significant level of influence on crude oil prices, will be incorporated into **Part-II** of the evaluation. **Part-II** will be conducted as a separate thesis project.

Part II: In **Part-II**, a statistical model will be developed in which each significant factor identified in **Part-I** is assigned an appropriate weight of importance (**an elasticity with regards to price**) and a probability distribution indicative of likeliness of occurrence (**a measure of risk or frequency**). These weighted factors and their probability distributions will be adjusted and hypothetical crude oil price results will be generated and compared to actual price history. The objective of **Part-II** is to create an empirical model for which all important factors, their weighted importance, and their chance of occurring are incorporated into a single simulation. The iterative process of adjusting factor weights and probabilities is intended to create a simulation that can produce predictions which closely coincide with actual historical crude oil price data. Such a simulation could then be utilized to forecast future crude oil prices given expected circumstances or contingencies.

Methodology: How To Build The Model: When confronted with the task of constructing a mathematical model, there is a temptation to rush ahead and begin crunching numbers and analyzing results. This is a mistake. A prudent evaluation calls for a methodical approach. We must first determine **WHAT** factors are important to analyze and **WHY**! This is necessary to ensure that we (1) account for as many significant factors of influence as possible and (2) have an understanding of why each factor influences crude oil price and should therefore be included in the model. This will also allow us to eliminate factors which may on the surface seem to be important but which have no real bearing on our model. We want to analyze the right things … not everything. Once we have carefully identified the factors of importance we must look to see if data is available. If data is available, terrific, but if not, we may have to choose a proxy-factor which closely mirrors the data we would really like to use. Finally, we must examine the reliability, consistency and credibility of our data sources. Although a useful model is never guaranteed, only quality data can hope produce meaningful results. The approach for **Part-I** will therefore begin with a rigorous examination of the relevant factors affecting crude oil price and seek to develop a reasonable understanding of how that influence comes about.

Background

Prior to 1973, crude oil was relatively inexpensive and few concerned themselves with understanding the mechanism involved in establishing price. Most believed, inappropriately, that oil and oil price behaved like any other commodity in an open market, depending solely on pressures of supply and demand. The oil embargo of 1973 sent shock waves throughout the industrialized world as OPEC nations effected a modest reduction in worldwide crude oil output. Although the cut-backs were highly selective, targeted at specific western powers supporting Israel during the Yom Kippur War, the net effect was an "energy crisis" with panic buying driving up crude oil prices nearly 350% in a single year. [1] The resulting uncontrolled and upward spiraling prices, fuel shortages and long gas lines, and the western world's seeming vulnerability to OPEC decisions demanded answers. Governments, industry and academia scrambled to understand the factors controlling crude oil price and supply. The hope was to regain some measure of control over prices and supply or to develop defensive strategies to limit the degree of price volatility.



The World Petroleum Market

In 1973, hundreds of separate activities began a quest to understand and model the crude oil market. An initial sensitivity analysis revealed that crude oil prices were affected by the anticipated factors of supply and demand.

Early Discoveries: On the Supply side, there were physical limitations to petroleum discoveries, reserves, and production rates from various oil fields. These producing regions were widely dispersed throughout the world and brought forth a wide range of crude oils which yielded a still wider range of products in varying quantities. Crude oils and their refined products were then marketed throughout the world in the regions demanding those products or possessing the necessary refining and storage capacity. This entailed a remarkably complex distribution and transportation system with a cost structure which accounted for export taxes, import taxes, tariffs, quotas and price controls. Researchers discovered that there **was no central mechanism for buying and selling crude oil and petroleum products**. The crude oil market was essentially a collection of contracts between exporting regions, transporters, refiners and marketers which effectively operated as a decentralized open market. [2] This was a holdover from the days when the oil industry was dominated by a few huge, vertically integrated oil companies who manipulated prices and supply according to their own monopolistic desires. On the Demand side, it was recognized that energy requirements were the driving mechanism and that "speaking about energy prices meant in effect speaking about the price of crude oil". [3] Demand for oil was derived from an overall demand for energy. Energy demand stemmed from population growth and its concomitant effects on industrialization and energy using equipment. This entailed understanding regional population growth, mechanization and the availability of alternate forms of energy and their cost structures relative to petroleum. The Gross Domestic Product (GDP) became one key measure in capturing the essence of this energy demand. It was also discovered that international trade balances and currency exchange rates further complicated a regional willingness to consume energy.

Complex Scenarios: Sensitivity analysis alone proved insufficient to understanding the petroleum market and answering the questions of western leaders. Having seemingly identified the important factors comprising supply and demand, researches now began to construct scenarios in an attempt to model oil market behavior. In my research, I located over 2,000 different books or publications within the University of Kansas' libraries which specifically addressed petroleum price prediction and mathematical modeling. Nearly all of these references had attempted to create models based on widely divergent assumptions and modeling templates and were constrained by unique limitations. **To properly review and understand the assumptions, detailed calculations, methodology employed and results obtained by this combined effort would take several years and significantly more resources than those available to perform the Part-I analysis of this study**. A partial review of these sources did provide useful insight however.

Initial Results: The bottom line resulting from the myriad modeling efforts developed by industry and academia during the 1970s is that the models developed were not effective at predicting petroleum prices. Useable results from Petroleum price modeling remains elusive. To reduce complexity, most of the models examined a single country or region of interest within a larger country. These models looked almost exclusively at the short term; what was expected to happen in the late 1970's and early 1980's based on market conditions of the late 1960's. Assumptions concerning political factors and/or OPEC policies were made and model predictions were generated. The initial results were mixed as these models failed to adequately describe the petroleum markets, either before or after 1973. Further work was required to achieve adequate results or even create a consensus among researchers. [4] Additional attempts to aggregate the individual regional models into a cohesive, worldwide model failed completely. [5,6]

Understanding Failure: The reason these scenario based models failed is significant and must be understood if an effective simulation model attempt is to be made.

♦ First, failure stemmed from the fact that the early models were based on time-series data pertaining to a particular region or country exclusively. Such models were overly simplistic, ignoring many important elements comprising the dynamic crude oil market as a whole. Additionally, these **models only strove to capture the short-term elasticities in regard to supply and demand**. [6] The concept that price changes set in motion corresponding supply and demand changes which experienced a significant delay in reaching a new state of equilibrium was largely ignored. For example, if heating oil prices increase, it is not likely to affect heating oil consumption during the upcoming winter season. However, higher heating oil prices, sustained over a five to ten year period, will cause individual and industrial consumers to shift to cheaper alternatives such as natural gas or to reduce consumption though better insulation or conservation efforts and thereby reduce oil demand over time. Since these models attempted to capture day-to-day, week-to-week and month-to-month price fluctuations, they broke down completely in the long run.

♦ Second, the nature of **developing differing sectoral and/or regional models** and then **attempting to aggregate them was flawed**. The structure of energy demand, access to transportation and different crude oils and products, rates of population growth and GDP, and the availability and cost structure of oil substitutes is profoundly different on a regional basis. Complicate this with politics, disparate tax structures, tariffs and quotas and the ability to meld different models into a single cohesive model becomes an impossible task. Several models were marginally successful but were limited to only a single product, like gasoline, within a small geographic region and applied for only a brief and selective time period. These models could not be generalized to account for price variations worldwide or in the long-run. [7]

♦ Third, limitations in data made working with many small countries or regions nearly impossible. Rarely was data complete and accurate nor was the data conveniently available and consistently recorded to support comparable regional models. [5,6] Additionally, the data studied frequently contained relatively few data points which contained a widely varying range in values. Such **limited data yielded inconsistent and unreliable results**. [7]

♦ Fourth, researchers had basically been attempting to **develop detailed models based on micro-economics**. The **complexity of the real world made such models impossible to use**. [5] For example, there is no single price of crude oil. Saudi Arabian light is different from the crude oils of Mexico, the North Sea, the Alaskan Reserves or West Texas. Not only did crude oils of differing quality command different prices, but the mix of crude oil grades and volumes delivered to various regional customers was in constant flux. The regional models had in essence attempted to capture this data almost on a transaction-by-transaction basis. The microeconomic approach to such complexities, even with the assistance of modern computers, proved too difficult.

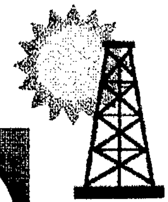
Macro-Economics: A Different Approach: The purpose of this thesis is therefore to attack the crude oil market modeling problem from a **macro-economic point of view**. The idea is to identify a **small number** of **large scale, aggregate components** to crude oil price and correlate them using **available** and **consistent empirical data** gathered over **a long period of time**. **Instead of attempting to validate a theoretical model we will use real data to construct and calibrate an empirical one**. It may not be possible to definitely establish causality but it is hoped that sufficiently strong correlations can be established to facilitate price predictions. This will be accomplished in several stages.

Stages: In the **first stage**, all factors to be evaluated must be identified and discussed in terms of their expected relevance to crude oil price. This will help identify what data to collect and what numerical factors to seek to correlate. In the **second stage**, appropriate data must be obtained. This data must be complete, as accurate as possible and cover extensive periods of time. The **third stage** will review the qualitative aspects of the history of petroleum to determine if or what events should be incorporated into the final model. In the **fourth stage**, the various data will be correlated with crude oil price over time. This will be done on a factor by factor basis and using a multiple regression analysis of all factors. Those factors which demonstrate a statistically significant correlation to crude oil price will be retained for more discrete modeling during **Part-II** of this evaluation.

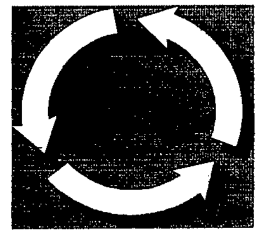
Perspective: To put the **Part-I** analysis into perspective, an analogy is appropriate. The petroleum price modeling efforts thus far attempted by academia, industry and governments alike were extremely complex and attempted to capture every possible effect. This is similar to attempting to understand the physical behavior of every molecule of gas in a room full of air. The historical models tried to calculate in effect, the mass, volume, charge, velocity, trajectory, kinetic energy, momentum, inter-attractive forces, etc. of each individual gas molecule as it interacted with the others and then aggregate the results to predict how the entire room of gas would behave. The complexities involved with capturing millions of pieces of data and accounting for millions of interactions among the molecules is frankly, impossible, and that is why these modeling efforts failed. The goal of the **Part-I** analysis is to develop macro-factors which can be correlated with real data to provide useful results. This would be analogous to measuring temperature **(T)**, pressure **(P)** and volume **(V)** of the gas in a room and developing a simple model, such as **PV = nRT** , to explain the behavior of the system. **R** is basically a correlation "fudge factor" derived from empirical data. With such a relationship, we can measure a few simple parameters (such as **P** or **V**), and easily predict **T** without having to understand or measure the true interactive complexity of the system. The **Ideal Gas Law** relationship has proved useful in predicting the behavior of gas systems and it is hoped that our analysis can identify a few appropriate macro-measures and associated correlation coefficients (fudge factors) to develop a similar model which can be used to effectively predict petroleum prices. In effect we will try to construct an eclectic model which seeks to include a wide range variables employed by numerous other models and then identify a macro-variable which is simpler to measure and use.

<u>Scope</u>: If macro-variables are to be identified and woven into a practical model, a decision has to be made concerning the scope of our efforts. In the **Part-I** analysis, all factors potentially effecting crude oil price will be analyzed on two macro-economic levels. The **<u>first level</u>** will assume a **<u>single, unified Global Petroleum Market</u>**. Under such an assumption, important factors to be correlated such as GDP, Population, Proven Reserves, etc. will be global aggregates. The **<u>second level</u>** will assume the **<u>United States</u>** is a **<u>single, unified, stand-alone petroleum market</u>** and U.S. aggregate data will be used. All relevant factors will be analyzed on each of these two levels.

<u>Reducing Variation</u>: Throughout the history of the U.S. and World oil markets, other than free market forces have occasionally been at work. The effects of noncompetitive pricing and supply controls were typically targeted at specific companies or countries. This often distorted the open market supply-demand-price relationships regionally. However, any cut-back in supply and corresponding price increase in one region was typically offset by a surplus and lower prices elsewhere. Utilizing Global (U.S.) **<u>aggregate data</u>** in a long-term analysis should provide a **<u>smoothing out effect</u>** for this phenomenon. It should also be noted that these events were of a short duration as both rapidly increasing energy demand coupled with an ever expanding number of new discoveries, producers and technologies has continued to **<u>drive conditions towards a free market</u>**. [8] One useful fact from past price-modeling efforts was the recognition that market fundamentals, worldwide economics, and business cycle forces consistently overwhelm the efforts of monopolies, governments and cartels (such as OPEC) which attempt to manipulate petroleum supply and price. [9] **<u>Basically, market fundamentals are stronger than politics in the long-run</u>**.



Stage I: Factors Of Relevance



Demand-Price Cycle: As demand for energy increases, relative energy shortages cause energy prices to increase. Increasing prices have both short-term and long-term effects. Such effects relate to energy demand through possible conservation and reductions in energy use or by consumers turning to less expensive, more abundant substitute sources of energy. Such actions, although slow to occur, eventually reduce energy demand (or the growth in demand) and create a relative surplus of energy in the market. This excess energy results in a decrease in prices in general which in turn stimulates economic growth. Increasing economic growth and prosperity eventually stimulate an increased demand for energy. The cycle then repeats itself. It should be noted that the short-term effects on energy consumption patterns have proved relatively unresponsive to price. In the long-term, however, changes in these consumption patterns, for example, towards use of more natural gas and coal and less oil, will have a profound influence on world energy markets. [7] The component factors of energy demand which effect the cost of energy use are numerous and intricately linked together. Each of these factors will now be addressed in turn.

Demand versus Consumption: Consumption is the amount of energy actually used by residential and commercial activity. In terms of petroleum, consumption includes crude oil produced from reservoirs (production), draw-down of inventory stocks and additional petroleum supplied by refining operations (cracking), Petroleum Gas Liquids (PGL) and coal-gasification and shale oil processes. The vast majority of petroleum consumed, however, comes from crude oil production with the other elements making minor contributions only. Basically, what is consumed each year is exactly what is produced from reservoirs with little exception.

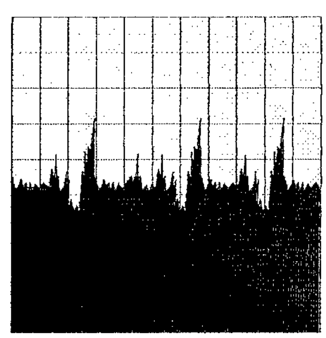
Unusual Events: More oil cannot be consumed than is supplied, therefore the ratio of petroleum produced to petroleum consumed is essential 1.000. A few minor deviations to this rule have been observed and are linked to **major inventory build-ups or draw-downs**. For example, following the 1973-1974 oil crisis, the United States embarked on a massive crude oil stockpiling project called the **Strategic Petroleum Reserve** (**SPR**). The **SPR** was intended to be a large crude oil resource which could be set aside and utilized to maintain oil supplies and prices for the U.S. economy during any future unforeseen production cut-backs in the world market. The purpose of the **SPR** was to reduce the volatility of U.S. crude oil supplies. During the **SPR** build-up, more crude oil was purchased (supplied) than was actually used worldwide, with the difference going into underground storage. In this case, the production to consumption ratio was slightly greater than 1.000. If the **SPR** is ever used to augment worldwide petroleum supplies, more oil will be consumed than is produced and the production/consumption ratio will be slightly less than 1.000. Since either of these events is extremely sporadic and of a very limited duration, they will be ignored in any long-term modeling of petroleum markets.

Price Drivers: Why discuss nuances in the definitions of production and consumption? We do this to distinguish demand from consumption and to show that **consumption data is irrelevant to an understanding of crude oil market price**. Demand is actually the sum of various economic pressures placed on the energy industry to provide energy resources. When demand isn't met, prices and production increase until the pressures are reduced. At any given time, what is produced equals what is consumed. Consumers, however, may have been willing to use and pay for even more resources, thereby making energy demands over and above that actually used. Production and consumption will be equal at some market clearing price in an open market. **Changes in demand, however, are what drives changes in price**. Consumption itself is superfluous. We now turn to those specific components of pressure which change energy demand.

Population: The effects of a growing population on energy demand are fairly obvious. More people require more energy and the rate at which a given population is growing is proportional to the rate of growth in energy demanded. Population growth varies widely around the world, and is particularly different between highly developed, industrialized nations and developing countries. Any crude oil-price model must evaluate the importance of both population and population growth rate on price.

Gross Domestic Product: While population levels and growth rates are indicative of a society's energy needs they don't capture the economic state within that society. Industrialized regions possess significantly more energy using (oil burning) equipment and consume far more energy per capita than do less industrial regions of an equal population. Various methods to capture this economic state include computing energy consumed per person, energy consumed per GDP, cataloging the number and capacity of energy using equipment, or measuring the total energy consumed. The most accepted measure of the economic state of a region (specifically countries) is the **Gross Domestic Product (GDP)**. The **GDP** is representative of the consumptive and productive capacity of a country as well as that county's relative wealth. The greater the **GDP**, the greater the wealth and consumptive energy demand. Because the **GDP** is widely computed and utilized, it is both an appropriate and convenient measure of the industrialized element of demand we seek to analyze. We will use **GDP** in our analysis. It should be noted that population growth is imbedded into **GDP** growth and explains about one-third of changes in **GDP**, while two-thirds of **GDP** is explained by productivity factors. If both population/ population growth rate and GDP/GDP growth rate show a strong correlation to crude oil price, it may be prudent to use only **GDP** related data to prevent over emphasizing population contributions.

Leading Economic Indicators: The U.S. Department of Commerce, Securities and Exchange Commission and the National Industrial Conference Board collate and publish various time series data for a range of economic indicators. These indicators range from production hours worked, to interest rates, to stock prices, to building permits, to the number of unemployed. These indicators are used by industry and government analysts who attempt to predict imminent and long-term changes in the overall economy or in specific



industrial sectors from the signals these indexes send. More often, composite indexes (weighted averages of individual index components) are used to smooth out random fluctuations in an individual index and reduce false signaling. The composite indexes are grouped into Leading, Coincident and Lagging indicators depending on when an index is expected to react to specific economic change. It may be possible to correlate these economic indexes, which are related to **GDP**, to crude oil price. **Since GDP conveniently assimilates an infinite number of variables into a single, useable number, it is the preferred factor to use in our macro-economic model**. Attempting to correlate the many economic indexes available to crude oil price begins to lead us towards the more detailed, micro-economic analysis which have historically proven unsuccessful. If we find only weak correlations of crude oil price to **GDP** data, however, it may necessitate turning to the more involved process of determining crude oil price correlations for the many economic indicators available in hopes of finding a stronger correlation.

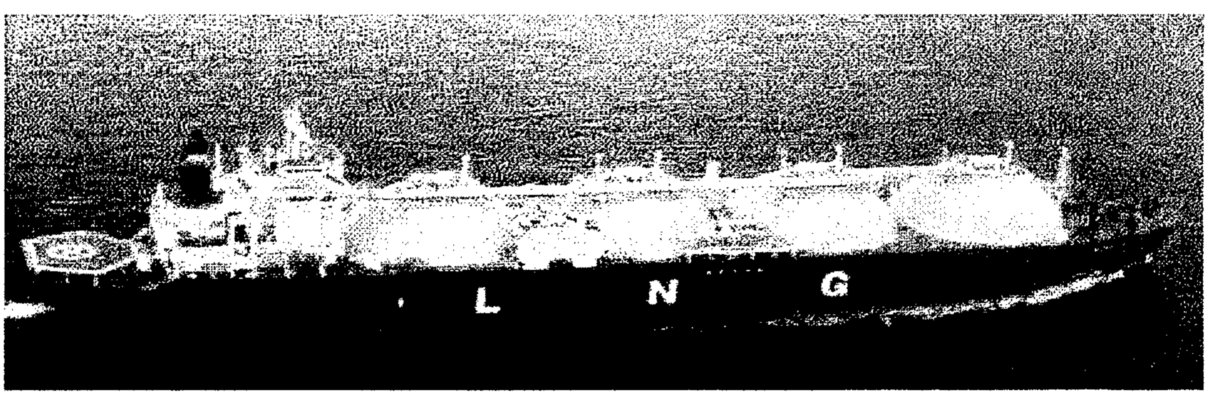
Reducing Complexity: To perform an analysis of Population and **GDP** as they relate to crude oil Price-Demand, a decision has to be made concerning which populations and **GDP's** to measure. The micro-economic approach requires that distinct regions be identified with their individual population and **GDP** statistics to develop demand data on a region by region basis. This approach is extremely complex and data intensive. The simple process of identifying a discrete region as requiring substantially different treatment from its neighbors is actually not so simple considering how dynamic population growth and industrial growth have been since the discovery of petroleum in 1859. Any given region would be expected to change its characteristics regarding population growth rates and degree of industrialization (as well as many other factors) several times during a given interval under long-term analysis. The continual shifting of these regional characteristics is almost impossible to capture, especially since these changes occur gradually. There is also the problem that regions of a similar nature requiring comparable macro-economic treatment will not conveniently fit themselves within national borders. Additionally, the time-history data supporting such an analysis simply doesn't exist for the large number of affected regions comprising a worldwide petroleum market. If we can't analyze individual regions, then what? We are simply left with a macro-economic approach in which large scale, aggregate population and **GDP** data will be used for the long-term price analysis. A short-term analysis of population or **GDP** effects is not prudent as these have historically been quite unpredictable. [10] Long-term, aggregate data is more readily available and we are relieved of the complex task of melding every changing regional circumstance into a cohesive model.

Observation: Reflecting on the Demand-Price cycle discussed earlier, it appears that population and **GDP**/mechanization are always increasing and that therefore energy demand must always increase. In practice, rising energy prices often cause economic slow downs and recessions and a reduction in **GDP** (or growth in **GDP**) which often counter-balances the energy demand increases associated with population growth alone. [11]

Alternative Energy Sources: The crude oil and petroleum products market does not exist in a vacuum. It is only one component in the entire energy market. The availability and cost of alternative sources of energy play a vital role in determining the price of crude oil. The primary sources of worldwide energy are oil, natural gas, coal, hydroelectric, and nuclear power. Additional minor contributions are made by solar, wind and geothermal sources, wood and trash burning and biomass energy. The mix of type and quantity of energy resources used in a given region is highly dependent on the resources available locally. Hydroelectric power isn't available where there is no water. One cannot burn coal unless coal is available. A country must possess the technological and monetary resources to construct a nuclear power industry before nuclear power is available for use.

Balancing Forces: Some regions have few indigenous energy resources while others have both abundance and choice. Some are net importers of energy while others are net exporters. An **equilibrium of energy exchange exists** in which energy is produced, distributed and consumed based on the relative cost of each type of energy as well as the relative energy requirements of various regions. The technological, production, refining and transportation costs associated with bringing each energy type into a region **determines the overall cost of that type of energy by region**. For regions rich in coal and natural gas but poor in petroleum, the relative cost of oil energy will be substantially higher than for coal or natural gas energy. Such a region would be expected to utilize relatively more coal and gas and less oil. This reduced use of oil would be an indicator of relatively higher oil prices.

Limits On Substitutability: There are limits on the substitutability between energy sources. While both coal and oil can be burned to produce electricity, only oil can be used to power automobiles and airplanes. Different types of fuel and fuel burning equipment have different thermal efficiencies and different environmental impacts. Attempts to capture thermal efficiencies for fuels, in the form of BTU's per energy dollar, have been relatively unsuccessful.



Pollution: Societal response to varying degrees of pollution related to energy use **remain difficult to quantify but is significant**. For example, rigorous economic analysis concludes that nuclear reactors are much more economical than coal or oil for producing electricity. Nuclear power, however, has continued to make limited contributions to the overall energy mix because of political and environmental concerns. [12] Additionally, burning of both coal and oil are coming under increasing environmental pressures for their contributions to air pollution and possible global warming effects. This has led to a push to use more "clean" energies such as natural gas, hydroelectric and solar power.

Accounting For Alternative Energy Sources: An obvious method would be to compute a ratio of the amount of energy consumed (by type) to the total energy consumed; oil BTU's/Total Energy BTU's for example . If this ratio is relatively high, it indicates a greater relative importance as well as a higher degree of dependence on that type of energy. We could therefore use the proportion of oil energy to total market energy consumed as an indicator of the value and availability of oil and hence price. Such a measure would implicitly include the cost structure and influence of alternative energy sources.

Time Lag: In the short run, energy consumption is not likely to respond much to price fluctuations or political or environmental pressures. A region will consume what it always has consumed. In the long-run, however, these pressures will drive energy consumers towards cheaper alternatives. [7] What this means is that a low energy market share is indicative of relatively more expensive energy costs. **The difficulty lies in assessing the time lag associated with pricing pressures and a subsequent change in consumption patterns**. Several studies indicate that changes to energy consumption patterns aren't evident until 5-10 years after the pricing/ political/ environmental pressures begin. Comparable changes in production patterns occur much more rapidly, and especially with regard to idle reserves and excess capacity which can be brought on line quickly. [10] Add to this, the uncertainty in measuring the degree of change in terms of both conservation measures and use of substitute products, and the problem worsens. What measure then can we correlate with energy prices?

Predictions: Following the above discussion, a high proportion of current energy use is indicative of relatively lower costs in the past (5-10 years previously). A correspondingly low proportion of use today indicates relatively higher energy costs in the past. Although we may be able to correlate the rate and direction at which the proportion of energy use changes in relation to past pricing pressures (accounting for the time lag), this doesn't help us predict future prices. It may be possible to make some reasonable future usage predictions (5-10 years ahead) to model current prices. The real difficulty lies in projecting energy consumption needs 20 years out in order to reflect pricing pressures 10-15 years out. This simply **isn't reasonable**. There are also significant assumptions concerning the proportion of energy which will be supplied by petroleum, political and economic stability, etc. which make such predictions highly suspect. The bottom line is that there **simply isn't a clear, convenient method to account for energy substitutes explicitly**. For now, we must understand that there are relatively un-measurable forces shaping consumption patterns and that adequate micro or macro-economic variables are not always available to capture these effects. We acknowledge this limitation in any subsequent correlation or model developed. It is hoped that any correlation coefficients (fudge factors) developed by the use of an energy use ratio (BTU's oil/Total Energy BTU's) will implicitly and adequately capture these uncertainties.

Past Energy Usage: We have already hinted at this factor in our discussion of alternative sources of energy. Basically, population and the degree of industrialization do not change dramatically from year to year. Additionally, changes in consumption patterns in response to changes in energy costs occur slowly. It takes time for conservation efforts to gain momentum and become effective. Likewise, converting domestic and commercial energy using equipment to use an alternate energy source requires time and money, and must be accomplished in stages. This degree of past energy use is also implicitly tied to a country's short-term dependence on that energy resource. Energy use simply can't change much from year to year. The past energy use is analogous to an object moving at a constant velocity. Rising prices tend to slow down usage while falling prices tend to speed up usage. **Price then provides the accelerating forces necessary to accomplish a change in demand**.

Magnification: The more of a particular type of energy a region uses the more dependent on that type of resource the region is. For a region that is heavily dependent on petroleum, for example, it is unlikely that consumption will vary much from year to year. On the other hand, a region which only gets a small percent of its energy from oil would be able do without this source relatively easier and demand would be extremely price sensitive. **What this means is that the proportion of energy use acts like a magnifying force to price fluctuations**. When the proportion of petroleum to total energy consumption is high, the price of petroleum will be quite sensitive to changes in supply or demand. In other words, the more dependent on a particular energy source you are, the more volatile prices will be. The ratio of energy use, discussed earlier, may be able to capture this price sensitivity and the energy dependence as it relates to energy alternatives.

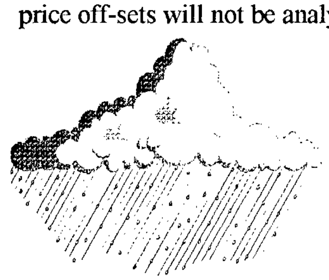
Oil Taxes: Oil Taxes take several forms. There are export taxes which are designed to provide revenues to exporting governments or to deter the export of oil products. There are also import taxes which are designed to provide revenues to importing governments, reduce dependence on foreign oil and protect domestic oil providers from global competitors. These taxes exist in varying degrees with regard to every exporter and importer of oil energy in the world. The net effect is that consumers pay higher prices.

All Things Considered: The contribution to price made by taxes, although large, should be **considered part of the distribution cost of acquiring oil and oil products** and not explicitly analyzed as a factor of price movement. It is incorporated into the various energy costs and mix of energy resources used in a region as discussed previously. Another way of looking at this is if taxes were reduced or eliminated in one region, new demand and supply patterns would be established as part of a worldwide distribution equilibrium. If another region wasn't satisfied with the share of oil it received, it could reduce taxes (and price locally) and once again realign demand in the worldwide distribution equilibrium.

Tax Policy Simplified: The fact that we are committed to analyzing price and demand on a macro-economic basis means that we have **to ignore the individual, regional tax differences**. The degree of complexity and lack of detailed regional tax data on the myriad variations over time make a micro-economic analysis hopeless anyway. Taken with the observation that the tax structures of most exporters and importers remains fairly constant, individual regional tax anomalies are not likely to affect global oil markets.

Tariffs And Quotas: Tariffs and import quotas have essentially the same effect as taxes; they add an additional component cost to imported oil and oil products. Currency exchange rates are also part of the cost of doing business. Using the same logic as applied to taxes, these incremental costs are simply part of the overall energy distribution cost matrix and should not be analyzed separately.

Price Controls: Price controls are different. They are political in nature and designed to protect the domestic oil industry or stimulate the economy. Price controls are employed to garner political support and are **not a consequence of open market forces**. The United States has been the primary region employing price controls to any degree.[13] During the 1960's, when crude oil was plentiful and world prices were relatively low, the U. S. artificially held oil prices high to protect domestic producers. In the 1970's, when world oil supplies were constricted and prices were high, domestic prices were held somewhat lower. In both of these periods, U.S. consumption patterns relative to the global open market price of oil were distorted. It is difficult to know how to quantitatively address this factor. The basic result was that there was a **price off-set**. The magnitude of these off-sets generally remained about the same and in effect, **became part of the overall energy distribution cost matrix** encompassing taxes, tariffs and import quotas. Using previously described logic, individual price off-sets will not be analyzed as a discrete factor affecting demand or price.



Climate: In the short run, climate can play a role in oil price. An unusually long and cold winter may increase regional demand for heating oils, driving up local prices. Such unexpected deviations from established energy distribution patterns are extremely short-lived and should be of little consequence in constructing a long-term oil market simulation model. Numerous models have attempted to account for weather through the use of widely reported cooling degree/heating degree environmental indexes. These efforts have proved unsuccessful and we will therefore ignore weather considerations.

Political Speculation: Throughout the twentieth century, uncertainty about the continued availability of oil supplies has prompted individual governments and industry to conduct speculative oil buying to assure themselves of adequate supplies. These speculative purchases were made without the use of credible economic indications of shortage or impending shortage, were irrational, and were therefore not part of open market forces.

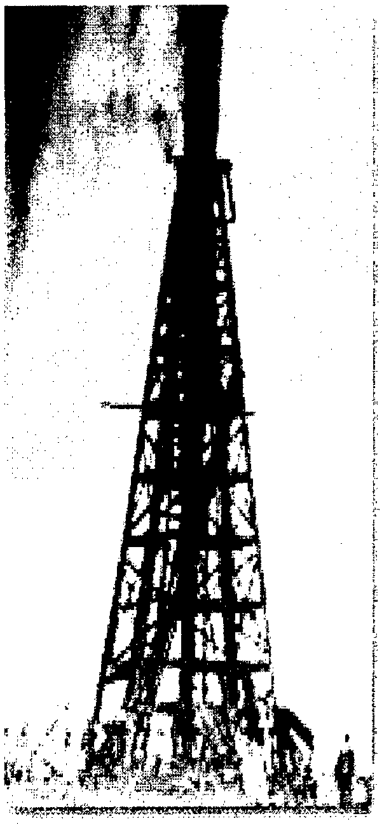
In spite of this, they had definite and pronounced effects on the availability and price of oil for brief periods. The short but vigorous price response to these speculative actions makes them more suited to the **qualitative analysis** stage rather than to make an attempt to account for them in a long-term quantitative model.

War or other Disasters: War, regional conflict, economic depression, natural disasters or political collapse can have definite impacts on the supply, demand and price of oil. The sporadic and relatively unpredictable nature of these events makes an analysis of their impact better suited to the **qualitative analysis** stage.

Supply: Total crude oil supply is derived from discovered reserves, unproved reserves, inventories, crude oil production, production gains from refining-cracking operations and petroleum-gas liquids (PGL). The assumption is made that an increase in demand will result in a proportional increase in supply. There is some difficulty in specifying supply or demand, for with numerous production and refining processes, differing grades of crude and a highly variable demand for light and heavy finished products, supply or demand could be interpreted in many ways (i.e., the supply of gasoline or the supply of Saudi Light Crude). The cost/price of these various products varies widely. For our purposes, **energy supply** and demand will be **equated to aggregate crude oil supply** and demand, and a single, **aggregate crude oil price will be used** to represent energy prices in general. [14] This is in line with our intent to model the petroleum market as either a single global market or as the U.S. market in isolation.

Supply-Price Cycle: When energy demand increases, demand for crude oil increases and crude oil prices rise as consumers compete for scarce resources. Production and refining facilities increase output to meet the increased demand. Petroleum reservoirs, due to their physical arrangement, have optimal extraction rates and thus have production limits. Additionally, existing tankers, pipelines and refineries, with their tremendous capital costs, are typically operated at or near capacity and little reserve surge capability exists. Pre-positioned inventories can alleviate short-term shortages, but any sustained energy demand quickly overwhelms existing capacity. The only remaining solution lies in locating and developing new petroleum reserves. Higher prices result in increased exploratory drilling and increased production from existing reserves when feasible. [15] This pressure leads to new discoveries and the construction of new production, transportation and refining capacity. As may be imagined, the time from a sustained increase in energy demand and crude oil price, to the time when new resources are brought to market, is measured in years and in billions of dollars in capital investment. As new sources of supply ramp up production output, the increased demand becomes satisfied and the relative scarcity dissipates. As production capacity exceeds demand, energy/oil prices drop, making additional exploration and drilling unprofitable. As exploration and drilling activity wane, the petroleum industry settles out at a new level of optimal production output. Eventually, the pressures of increasing demand begin working until a significant rise in prices is once again experienced. The great capital expense and significant time-lag involved with locating and developing petroleum reserves precludes the petroleum industry from mirroring the relatively linear increase in demand and therefore **condemns the industry to a constant cycle of overshooting**

and undershooting needed supply. [15]



Crude Production: The first and most important element of the supply cycle is gross crude oil production. One might argue that Total Supply, which included the products of refining-cracking, petroleum gas liquids (PGL), and coal-gas and shale-oil operations, in addition to gross crude oil production, would be more appropriate since we are attempting to capture the relationship of total supply and total demand in our model. The difficulty in calculating total supply in this fashion is that reliable data for production volumes for these secondary sources is not readily available or consistently reported throughout the world. It is reasonable to assume that if demand for crude oil were to increase by 10%, that each of the components of total supply (gross crude production, cracking, PGL, etc.) would each increase by that same 10% to meet the demand. It is also reasonable to state that the vast proportion (>70%) of Total Supply is accounted for by gross crude oil production and that **any measurable shift in production would be completely representative of a shift in Total Supply**. Since we are trying to correlate a change in Total Supply with price, we should be able to use **gross crude oil production** as a **reasonable proxy for Total Supply** in our model.

Assumption: A key assumption in the use of gross crude oil production as a proxy for Total Supply is that the secondary sources remain exactly that, **secondary**. If energy prices and demand increase to the point where coal-gas and shale-oil operations and thermal and catalytic cracking and reforming operations become significant and independent contributors to Total Supply, gross crude oil production alone may prove to be unrepresentative by itself. For the purposes of this study, the assumption that gross crude oil production is an excellent proxy for Total Supply is presumed to hold.

Considerations And Simplifications: In attempting to understand gross crude oil production, there are several factors to consider. The level of production is constrained by the physical size of a given reservoir and other geologic factors such as rock porosity, reservoir pressure and temperature, viscosity of the crude present, the amount of gas and water present, etc. Crude oil production may be enhanced by polymer, steam, water or gas injection processes. Crude oil production may be constrained by the number of wells which can be drilled due to climatic or geographic hardship such as those involved with arctic or off-shore production facilities. It may also be constrained by a limited distribution or storage system whereby available tankers or pipelines simply cannot remove product to refineries or markets any faster. Price is also a significant factor. Unless the crude oil can be produced profitably, oil will not flow. These variables are further complicated because they vary considerably from reservoir to reservoir and change for individual reservoirs over time. There is no meaningful way to capture the vast array of differences in production on a reservoir-by-reservoir, country-by-country or region-by-region basis. Our only hope is to use aggregate Global (U.S.) gross crude oil production data in our attempts to explain price. Once again we will ignore the micro-economic complexities in favor of a macro-economic measure in our model.

Petroleum Reserves: Another important element related to crude oil price is the availability of known petroleum reserves. Reserves are an estimate of when supplies will run out given current product withdrawal rates. If reserves are deemed low and petroleum is relatively more scarce, petroleum prices are expected to be higher and visa versa. However, the use of petroleum reserve data to help explain price is not without complications.

Complications: Reserves are estimates and as it turns out, **extremely conservative estimates**. For a particular reservoir, as deeper wells are drilled and as actual production and depletion rate information is compiled, a better picture develops as to the total economic production potential of a given petroleum formation. For large formations expected to produce for 50-100 years or more, an accurate picture is decades in forming. Thus, production and reserve estimates for any given reservoir are **revised extensively** over the producing life of a given reservoir. Early calculations tend to significantly underestimate the actual recoverable volume present and thus, reserve estimates are constantly revised upwards. [16]

Price vs Reserves: Price also plays a major role in establishing the level of proved reserves. Proved reserves should perhaps better be called **reserves which can be economically recovered at this time**. If supply exceeds demand and prices are low then only the most efficient (least costly) producing reservoirs will be allowed to produce because only the cheapest oil can compete effectively in the energy marketplace. Such reservoirs would typically have substantial natural pressure driving petroleum towards recovery wells (primary recovery) and would tend to not involve significant and costly pumping, injection or secondary/enhanced recovery operations. The volume of reserves which could be economically recovered at this price would be understandably smaller. If prices were to rise significantly, then less efficient reservoirs/wells could be brought on line, secondary and enhanced recovery techniques could be employed and even coal-gas and shale-oil operations begin to make contributions. The volume of reserves which could be economically recovered at higher prices is understandably higher. The problem is that the amount of oil in the ground or the technological capacity to recover the oil hasn't changed, only the price. This means that **price affects the level of reported reserves** and **the level of reported reserves affects price** making it difficult to assign meaning to reserves estimates in our model.

Price: To account for the circular influences of price on various elements which themselves influence price, a method of relating past and current prices must be used. The best accepted method for doing this is to use a price-to-price ratio, such as the ratio of prices from 1982 to 1981 and correlate this ratio with the 1982 price.

Constructing a model in this way will allow any coefficient to capture the price rate of change and price momentum effects as well as implicitly linking past price influences into the model. At this point there is no reason to suspect one particular time-lag ratio over another (year-to-year minus one ratio vs year-to-year minus five ratio, for example) and the current and previous year pricing data will be used in this analysis.

Reserves Dilemma 1: Over time, there has been a constant threat of depleting proved reserves and running out of oil. Such speculation has boosted prices and led to a subsequent increase in estimated reserves. **Proved reserves alone ignore the dependence of recoverability on price**. Annual revisions and extensions to proved reserves have historically amounted to two-thirds of the total annual production in that given year. [17] Essentially, there seems to always be a concern that supplies will run out, but as price increases, new sources, now economically recoverable, are added in and we actually never run out! The bottom line is that proved reserves are an unreliable estimate of actual recoverable petroleum.

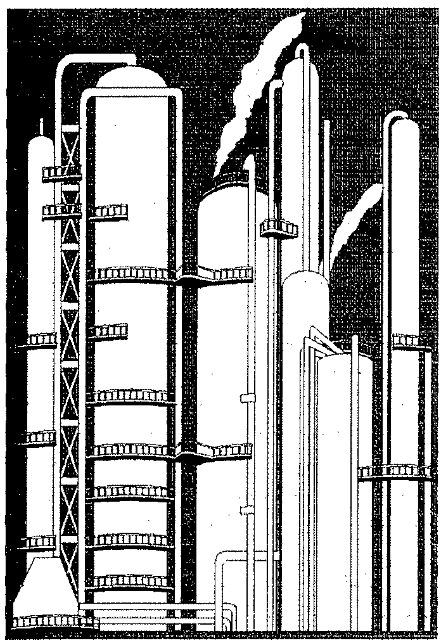
Reserves Dilemma 2: Another problem in evaluating reserves is that reservoirs are not conveniently located within geographic borders or in readily accessible areas. It is not always possible to adequately map out a given reservoir given these constraints. There may also be a problem of double-counting if adjacent countries report reserves for a reservoir shared by both countries. Strategic Reserves, such as the U.S. Strategic Petroleum Reserve (SPR), when compared to global reserves and are not significant and are not a factor in this study.

New Discoveries, Reserves And Price: Another component affecting reserves was alluded to in the discussion of the Supply-Price Cycle. Following a price increase, the amount of exploration and drilling increase and previously undiscovered reservoirs are added to the global reserve total or estimates for existing reserves are revised upwards. Studies indicate that the number and size of new discoveries are linked to price, the number and size of past discoveries, and to the degree of new discovery in specific geographic regions. Studies attempting to link the degree of new discoveries (new reserves) to price increases in specific geographic regions has not produced useable results. [4] The primary problem is that data is only available for regions encompassed by national boundaries and that what is needed is data based on areas of similar geologic conditions. Data is simply not available to support a model to this degree of detail.

Pressing Ahead: Despite the significant shortcomings of petroleum reserves they **do have an impact on price**. The best method for dampening out or smoothing over the regional volatility is to use Global proved reserves (U.S. proved reserves) in our attempt to correlate reserves and price. We know that the **absolute value of proved reserves is inaccurate**, but since the petroleum industry has consistently used this conservative approach in its estimates, we **may yet find a meaningful contribution towards price over time** in a multiple regression analysis including proved reserves.

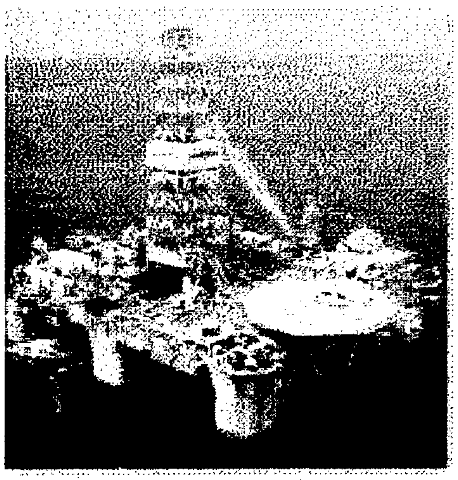
Reserve To Production Ratio: Another factor which we may be able to relate to price is the Reserve/Production ratio. Since such a ratio incorporates both production and proved reserves and is a **genuine indicator of the relative scarcity of crude oil** given current consumption rates, it may prove better than either Production or Proved Reserves in explaining changes in price. Since this ratio incorporates production and proved reserves it carries with it the assumptions and uncertainties associated with its components. A similar regional problem exists in attempting to capture Reserve/Production ratios for they vary from 100:1 down to 3:1 depending on the particular reservoir or geographic region. [18] For this reason, only a Global (U.S.) Reserve/Production ratio will be used, calculated from corresponding production and proved reserve data.

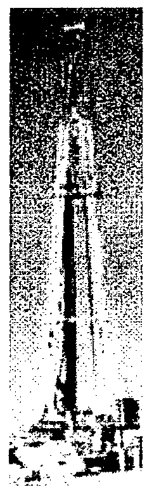
Inventories: In addition to Production, Proved Reserves and the Reserves/Production ratio, several additional factors should be considered in attempting to capture the effects of petroleum supply on price. One might want to consider inventories an important component but in reality they are **extremely small given aggregate world wide demand**. Inventories primarily provide a small cushion … a buffering volume allowing producers, refiners, transporters and retailers to make optimal, cost effective use of facilities and distribution channels. Inventories (with the exception of the **SPR**) should be viewed analogously to a cash drawer at a bank, necessary to accomplish daily transactions but insignificant when compared to the bank's true inventory of financial assets.

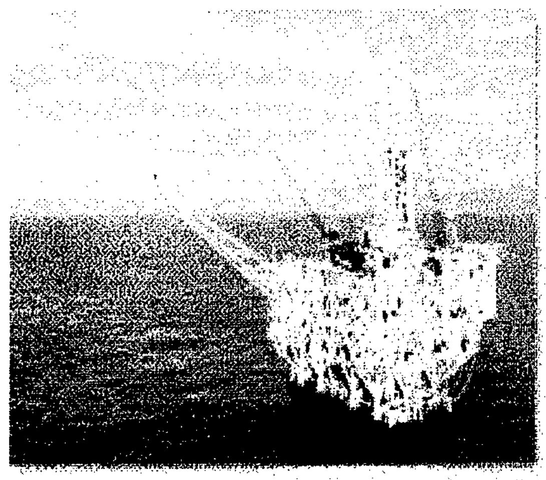


Bottlenecks: Experts have also attempted to **relate refining capacity to price**. This makes sense in theory, for if refining capacity became the limiting factor in providing adequate supplies of petroleum products, this should be linked to price. However, if refining capacity consistently exceeded refining demand, it would never prove to be a bottle neck and therefore have no substantial impact on changes in price. In fact, **refiners**, both large and small are quite numerous and exist in a **highly competitive market**. Such a market earns only a normal return on the capital invested and refiners are **extremely efficient at achieving just enough refining capacity to meet demand** without enduring meaningful periods of over or under capacity. [14] Similarly, the tanker and pipeline distribution industry is highly competitive and does not subject the oil industry to unusual price fluctuations. Basically, transportation (freight), refining (processing) and oil taxes are simply added on to the base crude oil export price. Although these elements make up a portion of the final crude oil price they are rarely involved in causally changing the price and therefore will not be examined in this analysis. Although this is the rational approach, markets don't always think rationally. If production and consumption levels increase relative to total refining capacity, then the market gets worried and prices tend to rise. We can capture this factor by correlating price to a ratio of Production/Refining Capacity.

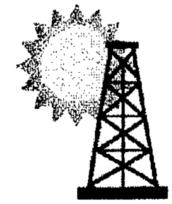
Exploration And Drilling: Experts have attempted to correlate petroleum price with the number of wells drilled in a given time period (drilling rate) and the rate of new reservoir discoveries. As discussed earlier, the number of wells drilled and the rate of discovery of new sources is linked to price fluctuations. This relationship is somewhat time-lagged in that drilling efforts increase after prices start to rise and taper off after prices start to fall. Both of these measures are a result of changes in price and not the other way around, however. More drilling does not necessarily result in lower prices although one would suspect that more drilling would lead to the discovery of new reserves and new production sources, eventually lowering price. The time lag between exploratory wells drilled and their impact on proved reserves and price may be captured by correlating price to the number of exploratory wells drilled some number of years previously.







OPEC: One final topic to address when considering supply issues is **OPEC**. In 1973, **OPEC** was able to briefly reduce the availability of global petroleum supplies and influence price. It was able to do this at a time when the quantity of reserves and excess production capacity was greatly diminished and when an increasing demand was about to precipitate significant price increases anyway. [19] The **degree to which OPEC was able to alter prices is still highly debated**. Over time, **OPEC** has suffered from lack of cohesion and discipline as a cartel and its production cut-backs have had relatively arbitrary effects on petroleum price in the long-run. With individual **OPEC** members constantly cheating on production limits and with the vast increase in non-**OPEC** discoveries, reserves and production capacity since the 1970's, **OPEC** can be considered to have a loose influence on petroleum price at best and at worst negligible effects on price. [20] A confounding factor for **OPEC** and an understanding of **OPEC's** influence is that if **OPEC** reduces production to raise prices it suffers a reduced petroleum market share and erodes its level of influence. The more **OPEC** squeezes supply, the more customers turn to alternative suppliers or meet energy needs differently and thereby deprive **OPEC** of its desired influence. The important point is that any component in the supply chain which can restrict or be perceived to restrict the flow of petroleum can act as a bottleneck and influence price. One quantitative method of determining the significance of **OPEC** on oil price is to calculate **OPEC's** share of total crude oil production (**OPEC**'s market share) to see if it has any correlation to price.



Stage II: Data

Key Factors: Through a reasonable application of logic, twelve key factors were identified and are suspected to have a measurable influence on crude oil price.

Directly Proportional

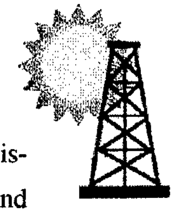
Population
Population Growth Rate
Gross Domestic Product (GDP)
GDP Growth Rate
Ratio of Energy Use
Production/Refining Capacity
Price/Price Ratio
OPEC Market Share

Inversely Proportional

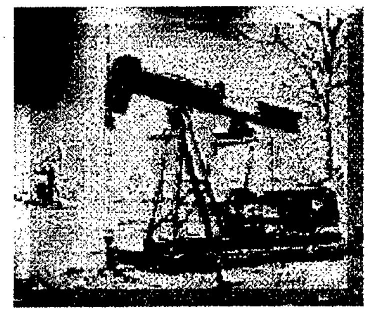
Gross Crude Oil Production
Proved Reserves
Reserve/Production Ratio
Exploratory Wells

The eight factors in the left column would be expected to increase price with an increase in the factor. We will attempt to correlate these factors directly with price. The four factors in the right column would be expected to decrease price with an increase in the factor. We will attempt to correlate the reciprocal of these factors (1 / Gross Crude Oil Production for example) to price. The correlations we obtain by relating price to a factor or 1/ factor is the obvious place to start, however, this tends to only capture linear relationships. It is also necessary to attempt price correlations with non-linear derivatives for each of these key factors. In this analysis, we will calculate the logarithm and the square for each factor and correlate those calculated quantities with price as well. In this way, we can determine if a non-linear relationship exists which may be stronger than or complement any corresponding linear correlation. These factors were selected as the best macro-economic variables for which data is readily available. Our goal is to attempt to correlate these factors to crude oil price over a long period of time to give our model viability. In assembling a model from any correlations we uncover, it must be remembered that most of the macro-economic factors and economic indicators we seek to use are often reported time late due to the necessity to collect, collate and publish data. This stipulates that our model will be useful to the extent of predicting crude oil price levels and expected changes to those levels on perhaps a quarterly, semi-annual or annual basis. It will not be possible to predict daily or weekly price variations using the macro-economic variables in our model. Our attention must now turn to identifying an appropriate period (number of inclusive years) for which to obtain that data.

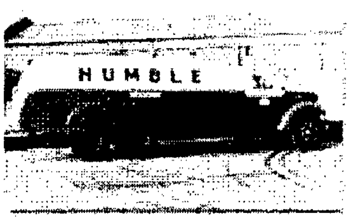
Data Requirements: An ideal period on which to base our model should be reasonably long (>20 years), have consistent data available for the factors we seek to study and be homogeneous. Homogeneity is crucial in that we want our model to be contemporary, that is, to work now and for the next decade or two. Since oil emerged into the market place in 1859, the petroleum industry has passed through many distinct phases as it evolved to the industry we know today. **The current petroleum industry is what we seek to model and we must therefore exclude any periods for which the characteristics of the oil industry markedly differ from the contemporary system**.



First Petroleum Era: Clearly the era prior to World War I is **completely dissimilar** to today's market. Discoveries were based on blind luck, the industry was rocked by violent booms and busts and wild growth and experimentation were the norm. Monopolies, such as Standard Oil, dominated the market and the independent producers. The environment was never considered and the kerosene product was used almost exclusively to light lamps. Several technological breakthroughs radically changed this infant oil industry. The invention of the electric light bulb in 1882 paved the way for electricity to replace oil as the source of light for residential and commercial customers. The invention of the internal combustion engine in 1896 revived the oil industry and generated a revolutionary transformation in which the automobile replaced the horse.



Second Petroleum Era: The period between World Wars was largely a **transition phase**. Anti-trust efforts broke up the monopolies and the large oil companies sought to extend their influence into **international markets**. Oil was discovered in new regions such as Persia, Mexico, Venezuela, Iraq and Saudi Arabia. Foreign **oil concessions became the dominant theme** as oil moved to the center of the energy picture. Oil burning ships, airplanes, and power plants joined the automobile in their demand for more oil. Economically, the world experienced the high of the Roaring Twenties and the low of the Great Depression. The United States was a relatively passive player in world affairs. The difficulties in communication and transport left large portions of the world isolated. During World War II, the United States emerged as the dominant economic, military and political influence on world affairs. In the aftermath of WW II, much of the world was rebuilt or dominated by democracy. The U.S. oil reserves and oil industry were critical to achieving this sudden transformation and economic growth. The power struggle for global dominance clearly shifted to a struggle for dominion over oil.



Third Petroleum Era – Great Transition. Following WW II, the U.S. and the world began **building roads** and automobiles at record pace. The petrochemical and plastics industries emerged along with **technologically advanced methods** for the location and production of crude oil. Telephones, televisions and jet airplanes closed the **communication gap** and more closely linked disparate global economies. Superior economic growth resulted from massive infusions of oil energy used to construct a modern industrial base.

Stupendous Demand And Change: Between 1948-1971, U.S. oil consumption rose 300%, European consumption rose 1,500% and Japanese consumption rose over 13,000%. During this same period, the number of cars in the U.S. increased from 45 million to 119 million. Outside America, the number of cars increased from 18.9 million to 161 million as the global automobile industry flourished. [21] New roadways and a migration of people to the suburbs was behind the ever increasing number of cars. By 1976, nearly 90% of population growth in the U.S. had settled in suburbs, necessitating commuting, and thus, more automobiles.

The Interstate Highway Bill of 1956 provided for the construction of over 42,000 miles of new roads. An entire industry of hotels, restaurants and service stations exploded across the landscape to support an increasingly mobile population. [22]

A Shifting Repository Of Wealth And Power: Between 1948-1972, world crude oil production increased from 8.7 to 42 MMbbls/day. The U.S. went from producing 65% of the worlds total crude oil to less than 22% as developing countries in the middle east joined the production frenzy. The status of proved oil reserves shifted from the U.S. controlling 33% of 64 billion barrels of crude in 1948 to controlling less than 7% of nearly 666 billion barrels available by 1972. This was a time of great economic growth and of significant instability and transition for the petroleum industry. **Concessions still dominated** the foreign oil industry and price was largely controlled by exploitive, long-term contracts. Crude oil import quotas were imposed by the United States from 1959-1973 and kept U.S. oil prices excessively high to protect domestic oil producers. The **oil industry was still far from an open market**. Events, such as the 1956 Suez Crisis, in which Egypt nationalized this critical trade choke point, set the stage for the downfall of concessions and for the emergence of an open petroleum market. [23]

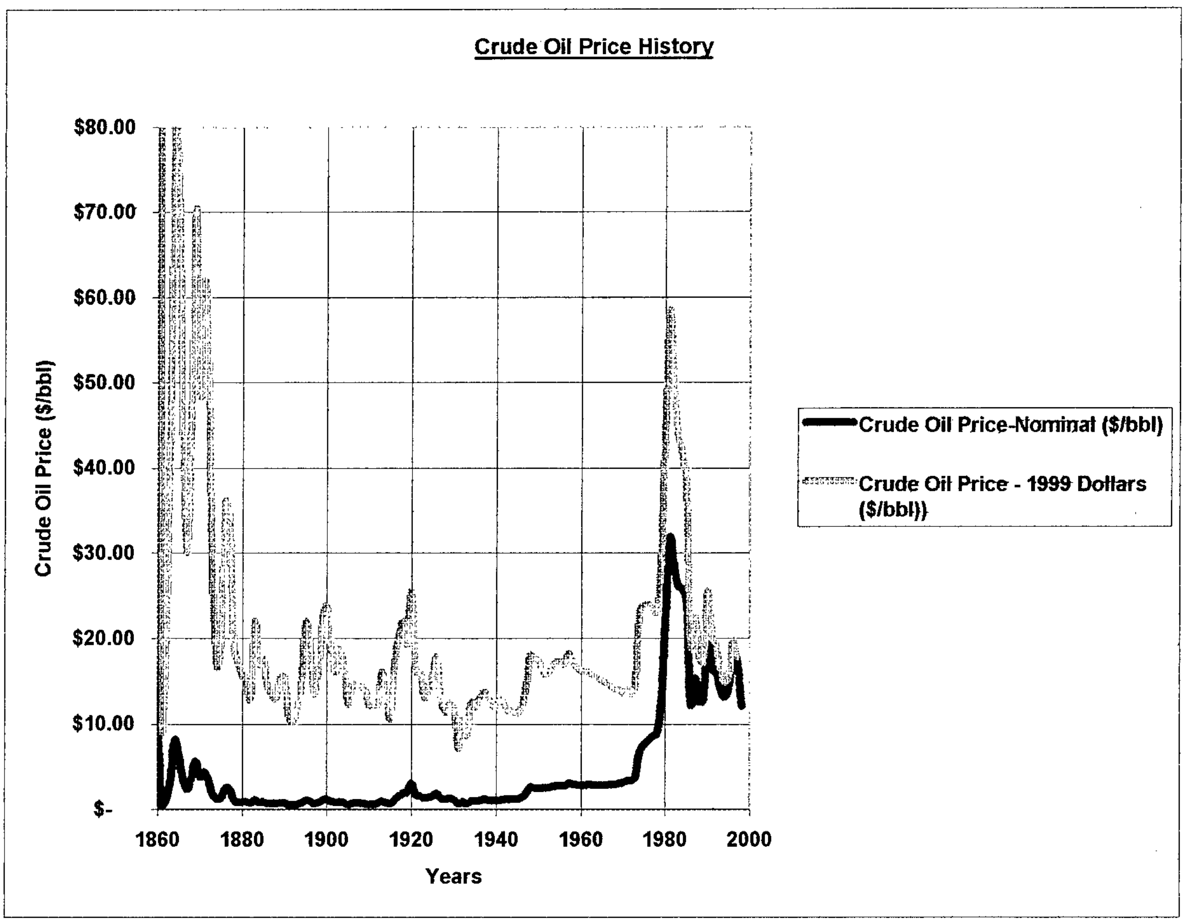


Figure I: Source: Energy Information Administration, 1997 & www.orst.edu

__Reflection__: **Figure I** is illustrative in helping define the different petroleum eras. Crude oil price, both Nominal and inflation adjusted to 1999 dollars, is plotted over time. It is obvious that the period from 1860-1890 is quite different from the 1890-1945 period. It is equally obvious that crude oil price patterns during the period 1945-1970 were substantially different from those between 1970-2000. 1970 corresponds to the moment when OPEC overtook the U.S. and gained a 50% market share of the world petroleum production output. [24]

__Comparison__: **Figure II** depicts a comparison of aggregate world crude oil production since 1945. Aggregate world production increases logarithmically until about 1970 when the aggregate growth rate becomes notably linear. **Figure III** shows the percentage of gas wells drilled in the U.S. since 1945. The sharp increase around 1970 indicates a significant change in energy production and consumption patterns.

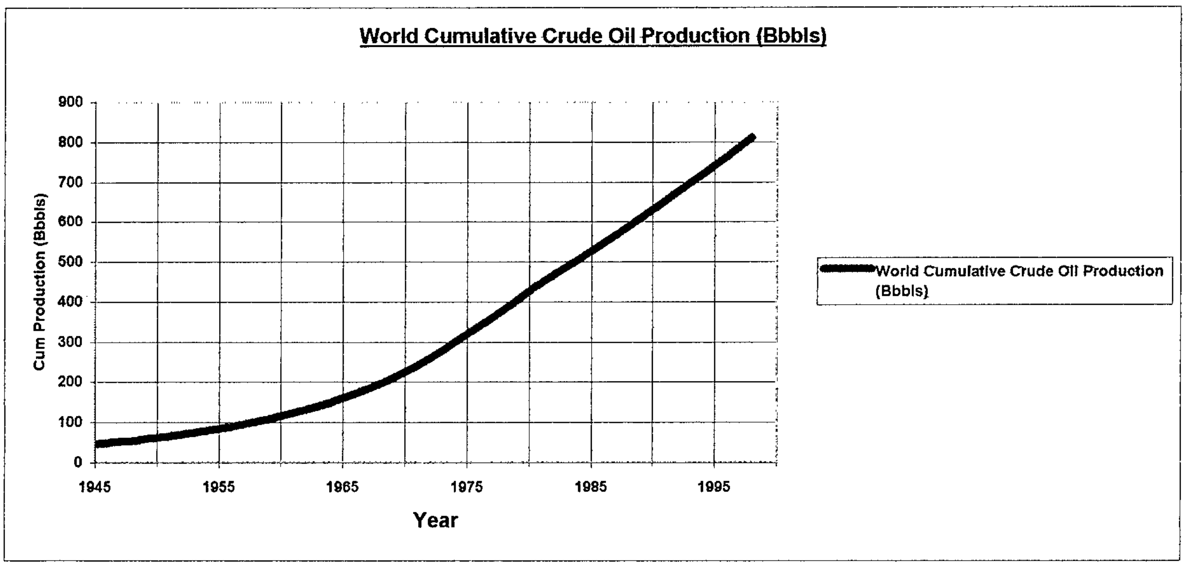


__Figure II__: Source: Twentieth Century Petroleum Statistics, 1998

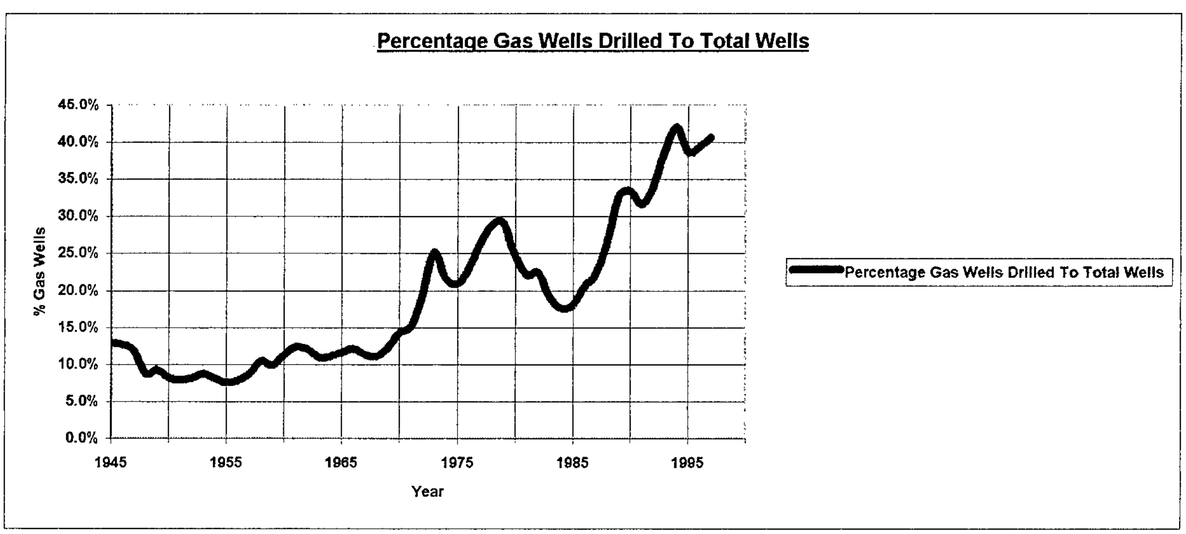


__Figure III__: Source: Twentieth Century Petroleum Statistics, 1998

Figure IV shows the percentage of U.S. crude oil imports since 1945. It also indicates a sharp break with the historical trend around 1970. **Figure V** depicts the average cost per foot for drilling new wells in the United States. A 700% price increase beginning in 1971 signifies a dramatic change. A reasonable hypothesis is that a flood of new environmental protection laws such as the National Environmental Policy Act (NEPA 1970), the Clean Air Act Amendments (1970), the Clean Water Act (1972), the Safe Drinking Water Act (SDWA 1974), and the creation of the U.S. Environmental Protection Agency (1970) all created vast additional legal and environmental costs for companies pursuing oil exploration and development. It is also reasonable to assume that most of the easy to reach oil reserves had been found and that the preponderance of new oil reserves would necessitate exploring in more inhospitable and expensive locations.

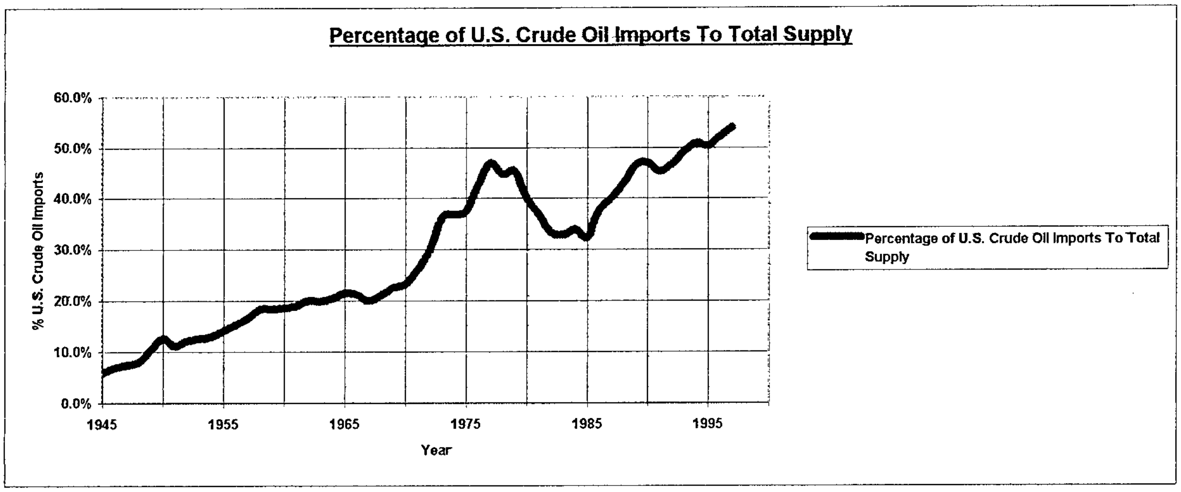


Figure IV: Source: Twentieth Century Petroleum Statistics, 1998

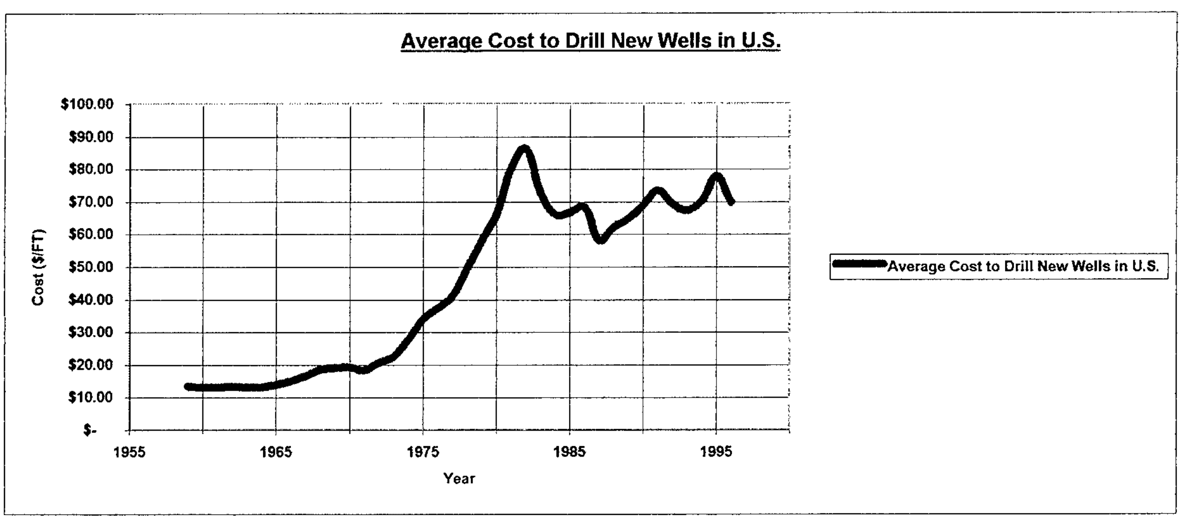


Figure V: Source: Twentieth Century Petroleum Statistics, 1998

Figure VI shows total U.S. energy demand over time. For about 25 years immediately following WW II, U.S. energy consumption ramped up steadily and steeply but then nosed over sharply and remained relatively volatile after 1972. **Figure VII** indicates U.S. economic growth since 1960. This data suggest a period of slow linear growth ending about 1972 followed by a period of much faster linear growth starting about 1974 and continuing until today.

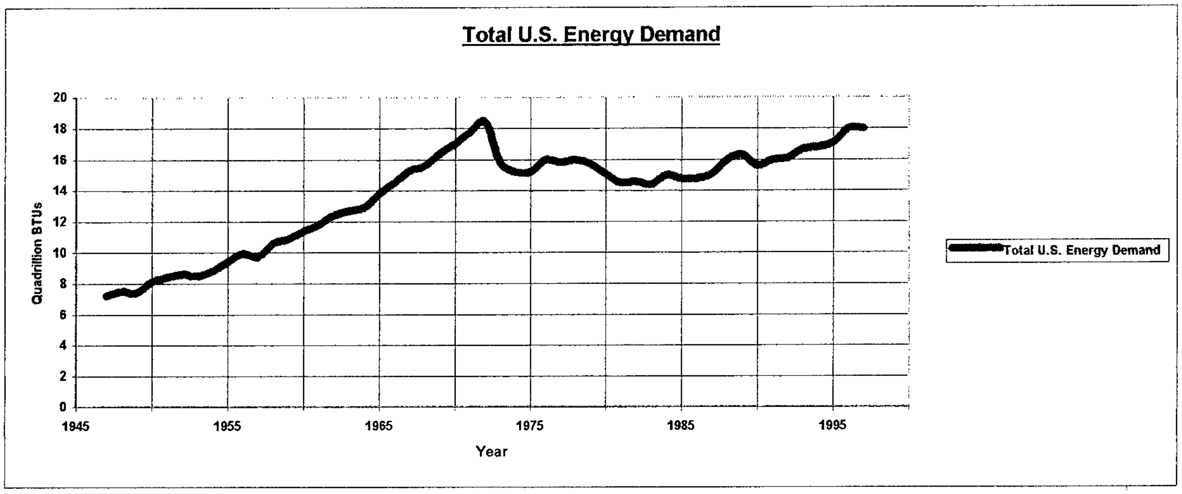


Figure VI: Source: Twentieth Century Petroleum Statistics, 1998

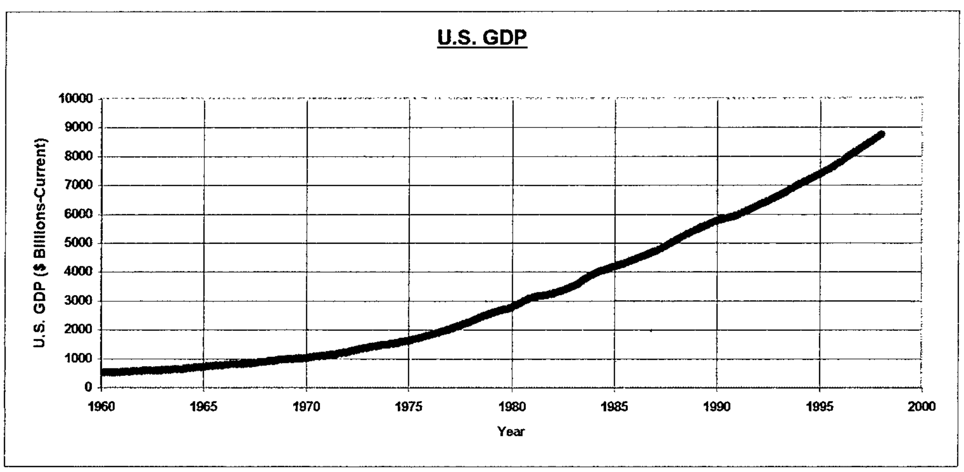


Figure VII: Source: www.worldbank.org

Figure VIII reveals that the U.S. population growth rate declined sharply until about 1969 and then transitioned to a substantially more modest growth rate in the three decades that followed. It also reveals the world population growth rate during the same period and shows a decade long stretch where growth rate peaked out, followed by a sharp break in 1971 and a steadily declining growth rate since.

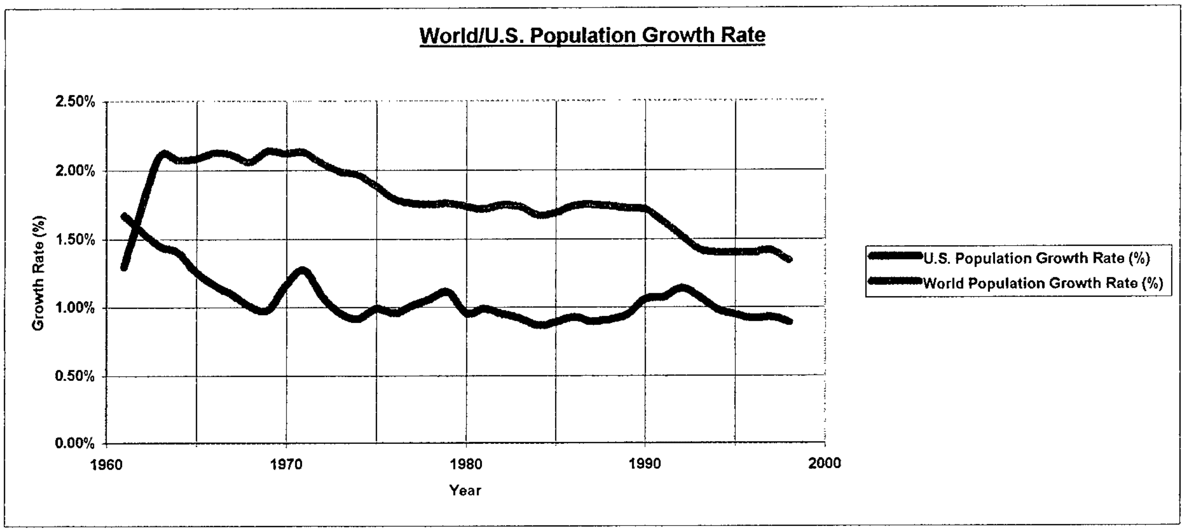
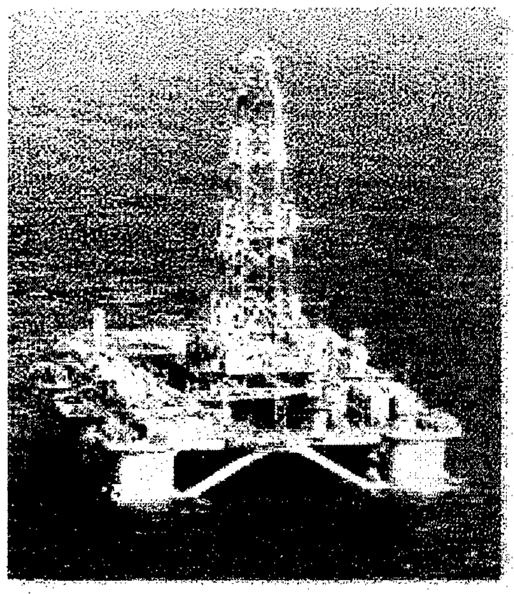


Figure VIII: Source: Twentieth Century Petroleum Statistics, 1998

Conclusion: An examination of each of the eight preceding figures cannot be considered exhaustive or imply specific causality as to why the economic environment changed around 1970. **The results and not the cause are what is important**. **The decision to focus on data analysis for the period 1970-1999 and exclude petroleum data prior to 1970 is monumental**. Such a decision required that we devote a substantial effort to convince ourselves that the petroleum industry can be characterized in a markedly different way after 1970. The data support a strong conviction to this effect. For the purposes of this analysis, the current petroleum industry will be taken as beginning in 1970.

Stable Or Not?: The period from 1970-1999 has not been entirely stable, however. Oil had become a matter of state policy and national security and represented power which could be used as a weapon. The Carter Doctrine, issued in 1980, clearly established that attempts to illicitly control oil would be viewed as a direct national threat to the U.S. requiring strong political and military response. [26] The 1973 Yom Kippur War which precipitated the first major "oil Crisis" is illustrative of how oil power was able to achieve political aims. [27] The International Energy Agency was formed in 1974 to help understand, coordinate and moderate the effects of global oil pressures. The concept of an "Energy Crisis" was conveyed to citizens the world over to establish a direct link between oil and prosperity. **Oil was no longer a commodity, it was a vital necessity to sustaining a way of life**.

Changing Technology & Markets:. Particular to the modern petroleum era, off-shore drilling and horizontal drilling were possible and profitable and 3D seismic imaging techniques made the search for and evaluation of new oil reservoirs more exact. Oil discoveries in Alaska, Mexico and the North Sea added huge production volumes to non-OPEC producers. By 1980, non-OPEC producers had overtaken OPEC in crude oil production market share (**Figure IX**). By 1995, a market share equilibrium had evolved. This modern petroleum era was marked by several large shifts in crude oil production market share and corresponded to shifts in relative economic and political power. This doesn't appear particularly stable.



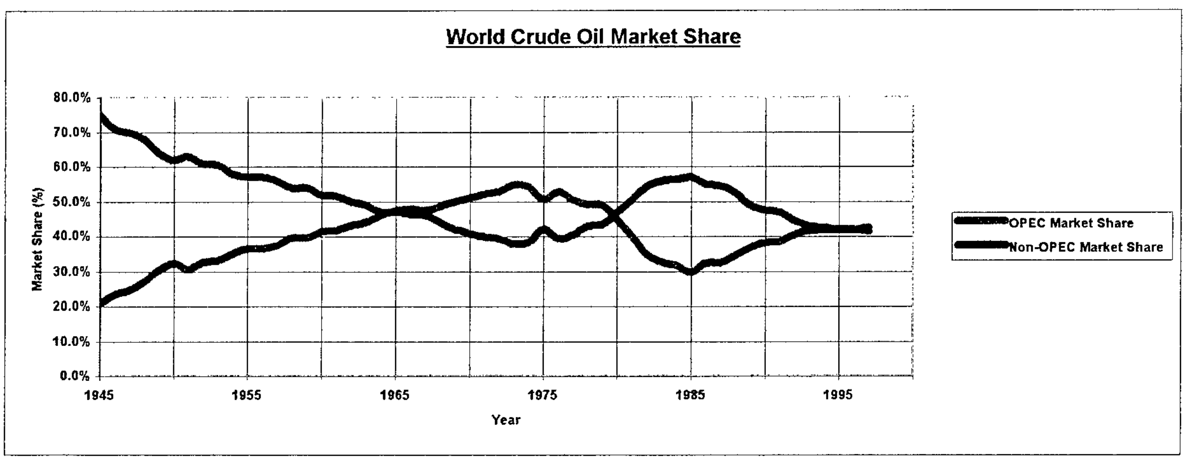


Figure IX: Source: Twentieth Century Petroleum Statistics, 1998

A Different Petroleum Market: Concessions had begun to fall apart in 1950 when a 50:50 profit sharing deal was struck between ARAMCO and Saudi Arabia. In 1970, the world was at a 99% utilization rate for oil; the surplus was gone and a sellers market prevailed.[25] The initiative had passed to the exporters. In 1970, the Shah of Iran was able to obtain 55% profits which paved the way for the Tehran Agreement in 1971 whereby all oil exporters were to realize 55% profits. By 1977 the last of the original oil concessions was gone, sovereign ownership was permanently established and the spot market emerged to fill the void left by dissolved long-term agreements. By 1980, deregulation had successfully lifted oil and gas price controls in the U.S.

Figure X indicates how U.S. and global oil prices tracked from 1970-2000. Notice the large price offset between Arabian Light (34) (taken as representative of world oil prices) and U.S. domestic oil prior to 1980. Initially, U.S. prices were off-set higher but from 1973-1979 U.S. price controls held the price off-set lower. After 1980, U.S. and world oil prices track much more closely indicating that open market forces were at work. The oil production and pricing mechanism evolved from a rigid, exploitive system which gave advantage to the buyers (1950) to an environment of relative shortage which gave advantage to the sellers (OPEC 1974-1978) to an open market system in which buyers and sellers completed oil transactions on a relatively equal basis (1985-2000). From this analysis of petroleum markets it appears that the period from 1980-2000 is most representative of the free market forces and that the oil markets underwent a transition between 1950-1979. However, the period from 1970-1979 marked the most pronounced change towards competitive markets and it is reasonable to include this period as being characteristic of the modern petroleum era also.

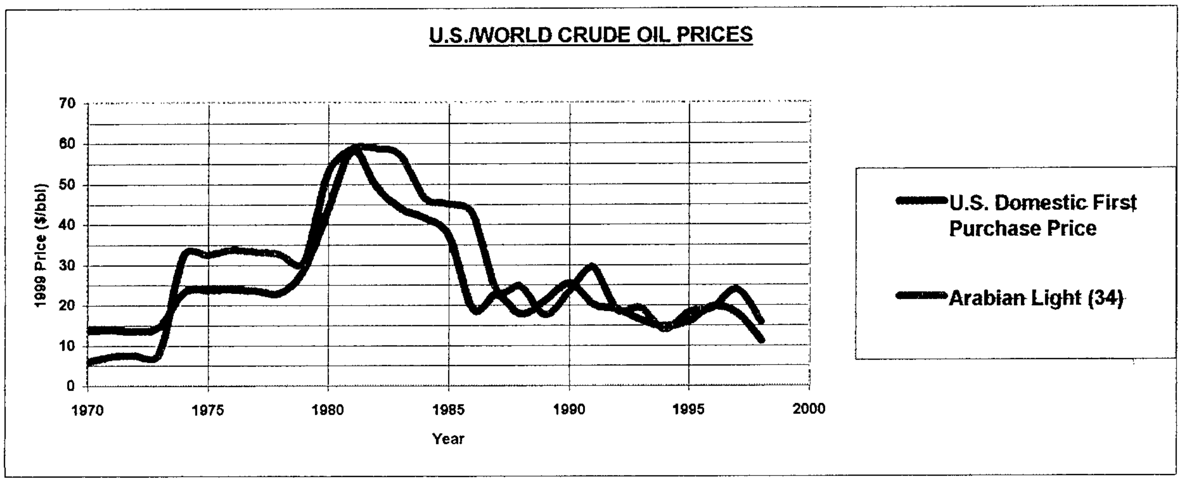


Figure X: Source: Twentieth Century Petroleum Statistics, 1998

Conservation And Environmental impacts: Once price controls were lifted in 1980, true energy costs were felt by industrial and residential consumers. By 1985, conservation efforts had reduced total energy consumption, a significant break from a century long trend of increasing energy demand.[28] As previously mentioned, environmental concerns exerted ever increasing pressure on the petroleum industry, both in areas of exploration and development and in spill control and liability. The Exxon Valdez disaster (1990) in particular resulted in numerous regulatory burdens on the oil industry.

Characterization: Although changes have occurred within the petroleum industry between 1970 and 2000, this period can be distinctly characterized by:

Oil being synonymous with power & an oil-power equilibrium being established

A move towards open markets, sovereign ownership and price/quota deregulation

New exploration and production technology

Environmental awareness and conservation

These characteristics are particular to the 1970-2000 period and thereby constitute the modern petroleum era we seek to study. In addition to the prominent shift in characteristics and trends which focused our attention on the 1970-2000 period, there are other data concerns we must address.

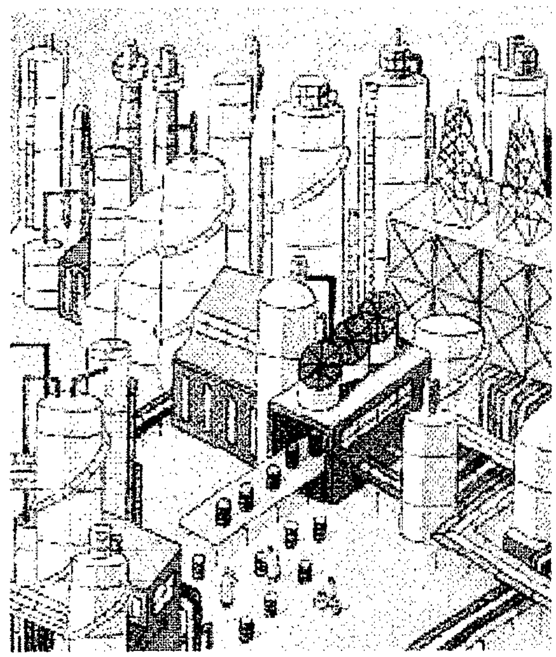
Missing & Incomplete Data: Some data simply doesn't exist while other data is incomplete. We alluded to more exotic regional data such as import/export taxes, rates of economic growth and energy use, and exact population estimates as being difficult or impossible to obtain for developing regions. Where data for basic economic factors such as crude oil production or imports does exist, it often hasn't be recorded credibly for long periods of time. Older data tends to be more suspect and global data prior to 1945 is largely incomplete or composed of rough estimates. Lack of credible and consistent data for basic petroleum industry variables tends to constrain any meaningful analysis to periods after 1945.

Data With Different Units: Throughout the numerous published resources pertaining to the history of petroleum one can quickly find many different unit bases in use. For example, crude oil production volume is typically expressed as;

1,000 Tons of Coal Equivalent
Metric Tons (MT)
Million Barrels (MMbbls)
British Thermal Units (BTU's)
Cubic Feet (CUFT)

While data can be converted into common units, rounding errors alone can account for **significant incongruity when attempting to compile a data sequence from multiple sources**. For example, the American Petroleum Institute (API) reports U.S. Proved Reserves in 1950 as 25.3 billion barrels while the Energy Information Administration reports a value of 25,268,398,000 barrels for the same year. The results are close but rounding error and a differing number of significant digits alone can throw off an analysis. **Significant variation will result simply by changing data sources** in mid-stream analysis and results will become more volatile simply because different data sources were combined. To avoid or minimize this effect, a single source of data for a given time period, 1970-2000 for example, should be used. Lack of consistence data sources prior to 1945 was a strong consideration in excluding the period from this analysis.

Reporting Source: Different data sources, such as the United Nations, World Bank, American Petroleum Institute, U.S. Department of Energy, U.S. Department of Commerce, Central Intelligence Agency, etc. have recorded and published petroleum data for different periods of time. In some cases there is overlap, when multiple sources report for the same period of time while in some cases there is no credible data available for certain time periods. For example, despite an exhaustive search, no global crude oil production data seems to be available for the years 1936-1937. Even when data is available it does not easily compare with reports from another source. **Production is not always production**! Some sources report total supply or refining capacity under the heading of production and include byproducts from thermal and catalytic cracking and reforming operations, petroleum gas liquids, gas oil, shale oil, inventory draw downs and eastern block and soviet contributions, in addition to gross crude distillation. It is often difficult or impossible to know which components were included or excluded from a particular reporting source. Some published sources clearly indicate what components were included while others fail to explicitly mention what the data is meant to include. Another problem is data sources which report consumption in the form of a major finished product such as gasoline while ignoring the volumes of secondary products. In some cases data is reported for major producers only, and secondary producers are excluded.



Discontinuity: Another danger when attempting to use multiple sources to complete a lengthy data timeline is discontinuities created simply by changing the data source. Unless resolved, such discontinuities may provoke the analysis to conclude that something unusual happened at a certain point in time when in fact, all that happened is that the data source shifted. For example, examine the data for U.S. Proved Reserves from two reporting sources shown below; the API data for 1949-1979 and EIA data for 1977-1998. The three years of overlapping data are shown below:

Year	API	EIA	Change
1977	29.49	31.78	-2.29
1978	27.80	31.36	-3.56
1979	27.05	29.81	-2.76

Volumes Are in Bbbls (Billions of Barrels)

The problem is that the overlapping years don't match up well. If your data stream had to transition from older API data to EIA data, then there would be a discontinuous jump in volume by 2.29 to 3.56 billion barrels depending upon the year in which the transition was made. This is **illustrative of how much of the data in the petroleum industry is recorded and of the danger of carelessly linking different data sources together indiscriminately**.

Data Gathering Pitfalls: How the data was gathered in the first place can be another cause for concern. A prime example leads us to look at published proved reserves data again. This data is derived from surveys sent though out the world. While respondents are given guidelines, there is latitude for **wide interpretation as to what to include**. Some countries fail to update their reserve figures meticulously or at all and their reports are useless. Others fail to respond at all and estimates must be used or that particular country's contribution left out. Other countries substantially under report reserve levels in hope of driving prices higher. Often new discoveries take years before being added into the total reserve picture. The bottom line is, even the source and methodology for obtaining data may be suspect for a particular published report.

Data Approach: Since we cannot reasonably go out and gather our own data we are **constrained to use data that is already published**. To minimize the possible negative effects discussed above we must choose both our data sources and our period of study to **ensure maximum consistency and continuity**. This means restricting the number of different sources employed and ensuring that continuous data is available for any one data stream. This approach generally precludes using data prior to 1960 and taken with the earlier discussion concerning the scope of the modern petroleum era we seek to study, leads us back to the 1970-2000 period.

You Get What You Pay For: It should also be noted that this is an unfunded research process and that all data used was data that was freely available. There are agencies, such as API, and private companies, such as the Oil and Gas Journal and WRTG Economics, which possess proprietary petroleum data which can only be accessed for a substantial fee. The U.S. Department of Commerce also publishes many important economic statistics which may correlate well with crude oil prices but which can only be obtained for a fee. One example is time series data for the Total Direct and Indirect Costs of Federal Government Regulation. Such data pertains to the costs of externalities imposed on industry and consumers by regulators such as auto emission standards, packaging and labeling requirements, worker health, safety and pollution laws. We already noted in **Figure V** a tremendous drilling cost increase which coincided with stricter environmental regulations in the early 1970s. This leads to the conclusion that there may be significant Department of Commerce, API or other proprietary data which could be used to establish much stronger correlations to crude oil price than the data which is freely available. The quality of this data is **presumed to be superior to the data used in this analysis**.

Reminder: It must also be remembered that we are not trying to capture the exact causalities and interrelationships of all variables involved. We have taken the practical approach which seeks to use reasonable macro-economic proxies which have a meaningful correlation to crude oil price. If the **trends for the proxy factors** can be related to the **trends in crude oil prices**, then **exact data is not needed**. The **Part-II** analysis can account for factors we failed to include or didn't recognize and inter-relationships or variables too complex to model effectively by using properly adjusted correlation coefficients (fudge factors) in our empirical model, if only we can establish that some relationship exists. To that end we press forward.

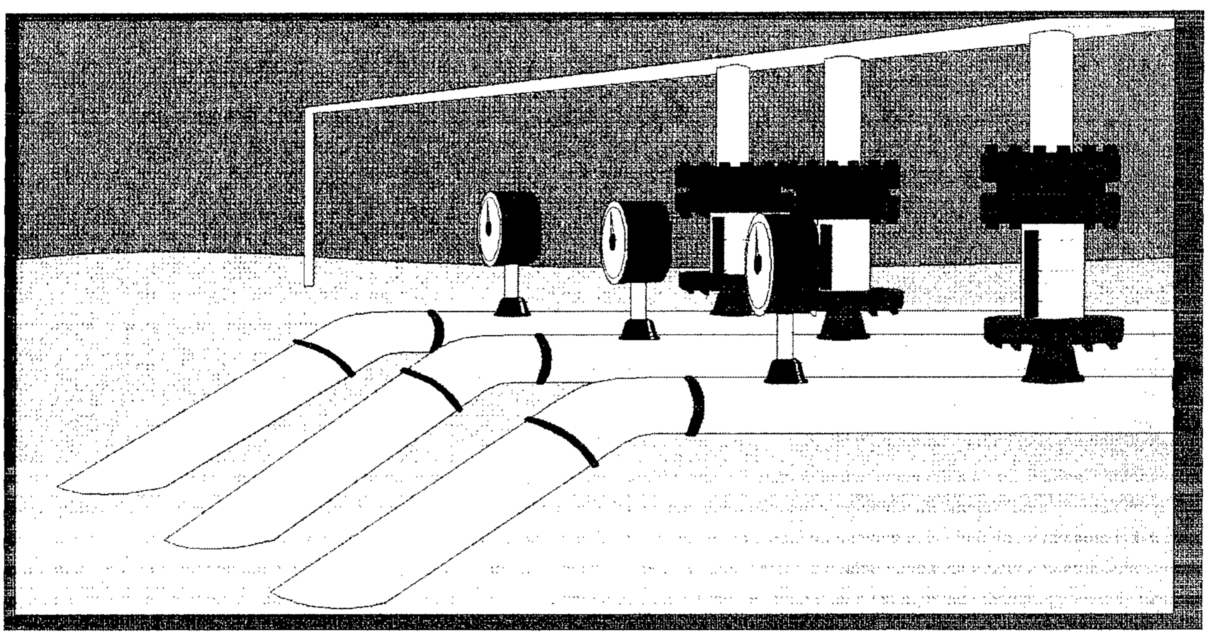
Raw Data: **Exhibit I** (5 U.S. Data Tables) and **Exhibit II** (4 World Data Tables) contain the raw and calculated data in tabular form for the variables and derivatives we seek to correlate to crude oil price. A 29 year interval (1970-1998) is taken as the modern petroleum era with the unique characteristics we seek to model. Although 29 data points in a data series (and in some cases as few as 21 data points) may lead one to question the statistical significance of the results, we will have to accept this uncertainty in our model. A substantial case has already been made which demonstrates that data prior to 1970 is expected to pertain to a different petroleum era than that which we seek to model and is therefore useless to us. As time goes on, additional data will become available which can be included in the modeling effort and which should reduce or eliminate the statistical limitations associated with a limited number of data points.

Data Sources: The table below indicates the raw data source used for each basic factor found in **Exhibits I** and **II**. U.S. First Domestic Purchase Price ($/bbl) provided by the Energy Information Administration, was taken as a good proxy measure of composite U.S. price. Arabian Light (34) is often considered to be a representative global crude oil price and was used as a proxy for a composite global petroleum price. Nominal prices have already been converted into current dollars (1999) as shown in both exhibits.

Factor	**U.S. Data Source**	**World Data Source**
Price	EIA	20th Century Petroleum Statistics, 1998
Population	www.worldbank.org	www.worldbank.org
GDP	www.bea.doc.gov	www.worldbank.org
# Exploratory Wells drilled	Oil & Gas Journal; 31Jan00, p-64	No Data
Production	20th Century Petroleum Statistics, 1998	20th Century Petroleum Statistics, 1998
Oil/Total Energy Use	Oil & Gas Journal; 25Jan99, p-58	Dept of Energy
Proved Reserves	20th Century Petroleum Statistics, 1998	Oil & Gas Journal, various (1970-1999)
Refining Capacity	Oil & Gas Journal, various (1970-1999)	Oil & Gas Journal, editions (1970-1999)
OPEC Market Share	Not Applicable	20th Century Petroleum Statistics, 1998

When examining **Exhibit I** and **Exhibit II**, note that each key factor and its corresponding data series is indicated with yellow high-lighted columns. Non-high-lighted columns contain input data or calculated derivatives for each key factor (the logarithm or square function). The Price/Price ratio was calculated using the given price data where the ratio for the current year was calculated using the following formula; P/P Ratio = P_N / P_{N-1} ; where P_N represents the current years price and P_{N-1} represents the previous years price. Population and

GDP growth rates were calculated from raw population and GDP annual figures. The reciprocal of the number of exploratory wells drilled, of production levels, of proved reserve levels and of reserve-to-production ratios were used as the prime factors due to their inverse relationship to price. The purpose of using the reciprocal of the factor and its non-linear derivatives was to generate positive, linear regression results during the statistical analysis phase. No global exploratory well data could be found and this factor will not be analyzed in the global model. The Reserve/Production ratio was calculated from the proved reserve and production data given. When it came to locating refining capacity data, most sources only included the crude distillation component of total refining capacity. Since this only represents about 60-75% of total refining capacity it was not representative of the data needed. The Oil & Gas Journal (various issues) did report comprehensive refining capacity data which included thermal and catalytic cracking and reforming capacity in addition to crude distillation capacity for both the U.S. and the world. Unfortunately, this data was only reported for the period 1970-1990 and no other comparable comprehensive data could be located. We are therefore limited to this 21 year period in calculating and analyzing the Production/Refining Capacity factor. The Oil Energy Use Ratio was calculated by dividing the magnitude of oil usage by the magnitude of total energy usage. World energy use data was only available for the period (1973-1996). OPEC market share was calculated as the ratio of OPEC crude oil production to world crude oil production. Also note that no logarithmic derivative for the World GDP Growth Rate factor was used because the logarithm of a negative growth rate is mathematically meaningless. For this factor, we relied on the square-function derivative alone to capture any non-linear effects.



Stage III: Qualitative Analysis

World Oil Market: Upon review of the petroleum market from 1970-1998, hundreds of individual events can be identified which have potentially impacted petroleum prices. The vast majority of these events, such as pipeline interruptions, refinery fires, new oil field discoveries, foreign nationalization of private oil company assets or unilateral price/production changes, have had relatively negligible immediate impact on crude oil price. The aggregate effect of these events undoubtedly is important to the overall balance of forces which shape price, but the individual effect is often impossible to model. For example, throughout the second half of 1999 and into the first half of 2000, a series of events occurred which drove petroleum prices significantly higher. The sequence began with several U.S. oil refinery fires in the summer of 1999 followed closely by a pipeline explosion near Seattle, WA and the destruction of a major Turkish refinery by an earthquake. These refining capacity setbacks coincided with the revival of the Asian economies after an 18 month recession. As 1999 wore on, the increased Asian energy demand and an exceptionally long and cold winter in the U.S. caused prices to increase. Finally, sensing an opportunity to achieve some short term price gouging, OPEC initiated a modest production cutback to push prices still higher. The point is that any single event would prove difficult to correlate to price change since there are numerous events occurring simultaneously and which may affect price in contrary ways and over differing time intervals. A new oil field discovery in one part of the world may be offset by a catastrophe elsewhere, with the net result indicating no change. If we are going to incorporate this qualitative type of data into our model, we must confine ourselves to include only those events in which crude oil price demonstrates a discretely measurable and singularly significant response to the event. We now turn to those events.

Major Events: After carefully studying the events of the last three decades, I conclude that there are three types of events to consider; Extraordinary Events, Significant Events and Aggregate Events. For the purpose of this analysis, Extraordinary Events are defined as causing a near 100% price increase. Significant Events are defined as causing a 25%-60% price increase. All other events are considered to be Aggregate Events for which a cumulative net impact may have an influence on price, but for which an individual contribution is not easily measured. For this analysis, Aggregate events will be ignored.

Extraordinary Events: Between 1970-1998, five Extraordinary events occurred which must be considered.

- The Arab-Israeli Yom Kippur War and subsequent oil embargo of 1973/1974. This was the first oil crisis and caused nominal prices to rise 400% in four months.

• The Iranian Revolution and deposition of the Shah in 1979 & the start of the Iran-Iraq War in 1980. Although two separate events, it can be considered one continuous crisis within Iran for our purposes. It is considered to be the second oil crisis and caused nominal prices to rise 260% over one year.

• OPEC institutes a series of pricing schemes in an attempt to regain significant price influence on the market in 1986-1987 resulting in a 175% price increase. The effect was short-lived as non-OPEC producers quickly increased production to return to open-market conditions.

• The Exxon Valdez oil spill in March 1989. Although the effect was short-lived, nominal prices spiked up 160% as a result of uncertainty about the flow of Alaskan oil.

• Iraq's invasion of Kuwait in 1990. Although the conflict was settled within six months, nominal prices spiked up 220% as a result of uncertainty about global oil flow, the result of the third oil crisis.

Throughout the modern petroleum era, an Exceptional Event occurs about every 6 years and caused prices to spike up about 240% on average.

Significant Events: Between 1970-1988, five Significant Events must be considered.

• Supply glut from 1980-1982. Nominal prices fell 25%.

• Open market forces take effect and spot prices are accepted globally in 1985. Nominal prices fall 60%.

• Dissolution of the Soviet Union in 1991. Nominal prices rise 25%.

• Supply glut from 1996-1997. Iraqi exports add to OPEC production increases to fuel global economy. Nominal prices fall 50%.

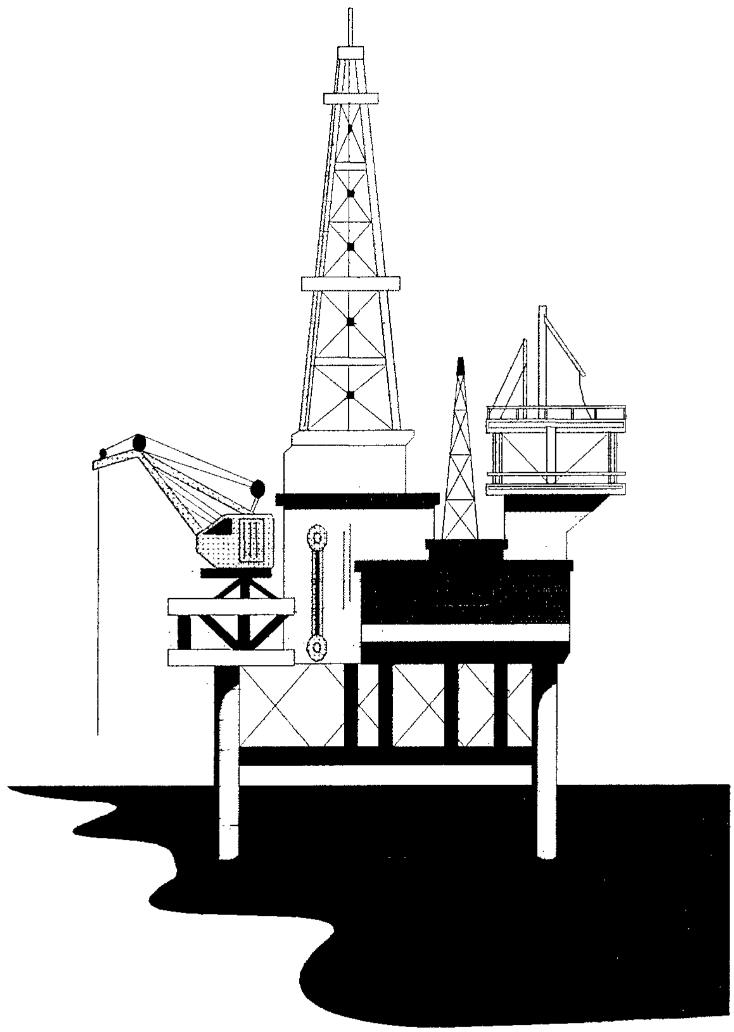
• Asian economic crisis of 1998 reduces worldwide energy demand. Nominal prices fall 33%

Throughout the modern petroleum era, an Significant Event occurs about every 6 years and causes prices to change about 40% on average.

The Model: In order to attempt to quantitatively capture the effects of these events, a crude correlation method will first be employed. Events will be assigned a dimensionless measure corresponding to the magnitude of price change typical for that event category. A plus (+) sign indicates that an event will increase crude oil prices and a minus (-) sign indicates that the event is expected to depress prices. An Exceptional Event will be assigned a magnitude effect of +/-5.0 (on a scale of –5 to +5, a Significant Effect will be assigned a magnitude effect of +/-1.0 and all Aggregate Effects will be assigned a magnitude effect of 0.0. The magnitude value for each event will be matched with the year of occurrence or the year in which the majority of the event occurred. These crude proxy data will be correlated to crude oil price over time. In this rough way we will attempt to determine the proportion of price which can be explained by Exceptional and Significant Events. If a correlation can be established then an iterative process attempting to match probability distributions and magnitudes can be used to refine the analysis in Part-II for both Exceptional Events and Significant Events.

Crude Quantitative Assigned Values for Qualitative "Special Events"

Year	Magnitude Effect
1970	0
1971	0
1972	0
1973	+5
1974	+5
1975	0
1976	0
1977	0
1978	0
1979	+5
1980	+5
1981	-1
1982	-1
1983	-1
1984	0
1985	0
1986	+5
1987	+5
1988	0
1989	+5
1990	+5
1991	+1
1992	0
1993	0
1994	0
1995	0
1996	-1
1997	-1
1998	-1



Stage IV: Analytical Results

Data Randomness: The first step used to analyze U.S. and World petroleum market data was to perform a statistical Runs Tests and generate a Control Chart for the U.S. and World price data series. The results of both tests revealed that the data was non-random. This confirmed our qualitative observations indicating that the period from 1970-1998 was not a neatly packaged event comprised of conveniently homogeneous forces and corresponding data. It also indicated that the extraordinary and significant events previously discussed may prove to be more influential on price than the other key quantitative factors. The Part-I analysis seeks to determine if a relationship exists between price and the key factors or their non-linear derivatives and was not concerned with capturing the exact magnitude of particular model coefficients. Therefore, there was no serious concern about the non-randomness of the data at this point in the analysis.

Individual Regression Analysis: Each key factor and its associated non-linear derivative was individually correlated with price using a statistical regression analysis software package. A summary of the results is shown in **Figure XI** at right. For detailed statistical results for each individual factor, see **Exhibit III** (U.S. Market Results) and **Exhibit IV** (World Market Results). In **Figure XI**, the R-Squared statistic indicates the amount of price that was explained by the factor on the left-hand side and the P-Value indicates how confident we are that the factor's contribution is significant. For our purposes, the higher the R-Squared statistic and the smaller the P-Value (preferably zero) then the stronger can be our belief that the particular factor has a significant effect on price.

	U.S. R-Squared	U.S. P-Value	World R-Squared	World P-Value
Price/Price (P/P) Ratio	8.6%	0.13	[illegible]	[illegible]
LN of P/P Ratio	8.0%	0.14	[illegible]	[illegible]
Square of P/P Ratio	8.8%	0.13	[illegible]	[illegible]
Population	[illegible]	[illegible]	[illegible]	[illegible]
LN of Population	[illegible]	[illegible]	[illegible]	[illegible]
Square of Population	[illegible]	[illegible]	[illegible]	[illegible]
Population Growth Rate	[illegible]	[illegible]	[illegible]	[illegible]
LN of Population Growth Rate	6.3%	0.20	[illegible]	[illegible]
Square of Population Growth Rate	6.5%	0.19	[illegible]	[illegible]
GDP	4.9%	0.25	4.3%	0.28
LN of GDP	[illegible]	[illegible]	[illegible]	[illegible]
Square of GDP	[illegible]	[illegible]	[illegible]	[illegible]
GDP Growth Rate	6.0%	0.21	[illegible]	[illegible]
LN of GDP Growth Rate	4.8%	0.26	NA	NA
Square of GDP Growth Rate	[illegible]	[illegible]	[illegible]	[illegible]
1/Exploratory Wells (EW)	[illegible]	[illegible]	NA	NA
LN 1/EW	[illegible]	[illegible]	NA	NA
Square 1/EW	[illegible]	[illegible]	NA	NA
1/Production (PROD)	[illegible]	[illegible]	[illegible]	[illegible]
LN of 1/PROD	[illegible]	[illegible]	[illegible]	[illegible]
Square of 1/PROD	[illegible]	[illegible]	[illegible]	[illegible]
Oil Energy Use Ratio (OEUR)	[illegible]	[illegible]	5.7%	0.26
LN of OEUR	[illegible]	[illegible]	6.8%	0.22
Square of OEUR	[illegible]	[illegible]	[illegible]	[illegible]
1/Proved Reserves (PR)	[illegible]	[illegible]	[illegible]	[illegible]
LN of 1/PR	[illegible]	[illegible]	[illegible]	[illegible]
Square of 1/PR	[illegible]	[illegible]	[illegible]	[illegible]
1/Reserve-Production Ratio (RPR)	[illegible]	[illegible]	[illegible]	[illegible]
LN 1/RPR	[illegible]	[illegible]	[illegible]	[illegible]
Square 1/RPR	[illegible]	[illegible]	[illegible]	[illegible]
Production/Refining Capacity Ratio (PRCR)	[illegible]	[illegible]	[illegible]	[illegible]
LN of PRCR	[illegible]	[illegible]	[illegible]	[illegible]
Square of PRCR	[illegible]	[illegible]	[illegible]	[illegible]
OPEC Market Share	NA	NA	[illegible]	[illegible]
LN of OPEC Market Share	NA	NA	[illegible]	[illegible]
Square of OPEC Market Share	NA	NA	[illegible]	[illegible]
Special Events	[illegible]	[illegible]	[illegible]	[illegible]

Figure XI: Individual Regression Results Comparison

Results high-lighted in green indicate factors which had a strong influence on price while those high-lighted in yellow indicate only a weak influence. Results high-lighted in red indicate no meaningful influence on price at all. In addition to the factors included from **Exhibit I** and **Exhibit II**, price was also correlated with our table of magnitude effect levels for the extraordinary and significant qualitative events discussed earlier. These results are listed at the bottom of **Figure XI** under the factor heading "Special Events".

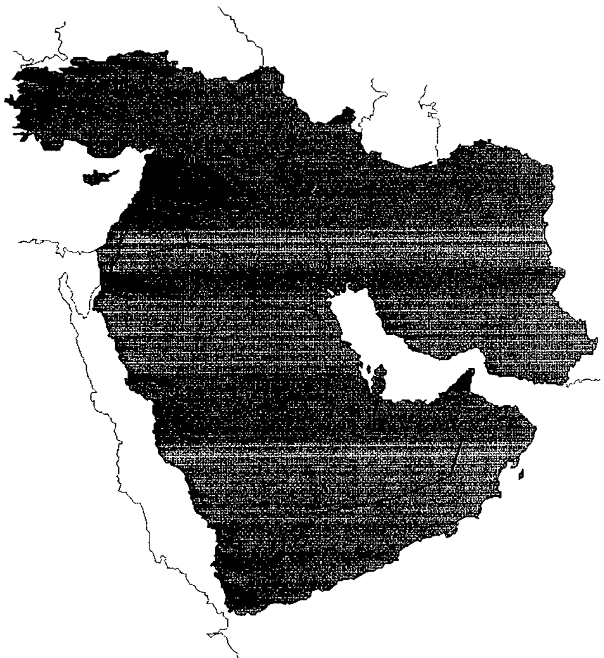
<u>Interpretation of Individual Analysis Results</u>: The initial step was to observe the similarities and differences between the U.S. and World market results. The previous price, population, population growth rate, GDP growth rate and ratio of oil energy use to total energy use had essentially no influence on price for either model. GDP had only a weak correlation to price but the square of GDP had a remarkably strong and significant influence on price for each model. We conclude that price is affected by GDP in a non-linear way.

It was somewhat surprising that previous price levels appeared to have little effect on subsequent price levels. Perhaps this indicates that the petroleum market is more sensitive to supply-demand pressures and less sensitive to momentum and perception than other commodities. The fact that population levels appear not to influence price while GDP does is suggestive that it is the relative wealth level per capita, and thus the energy consuming potential per capita, that is important in driving energy demand. Also surprising was the lack of influence of the oil energy use ratio. Increased dependence on oil should correspond to relative price insensitivity and thus higher prices but this is not borne out by the results. Perhaps this ratio is too simplistic and simply fails to adequately capture the effects of petroleum substitutes and their influence on price. <u>This aspect will require further investigation</u>.

It was interesting to note that production levels had a remarkably strong influence on U.S. prices but negligible influence on World prices. Conversely, U.S. proved reserves had little impact on price while World reserves made a significant contribution. No clear explanation presents itself as to why this could occur. It may be that our assumption that the U.S. market could be treated as an independent and isolated market is flawed. The U.S. market may be so integrated into the world market that separate analysis is not possible. If this is the case, then our final conclusions should be drawn largely from the world market analysis since U.S. market results are likely to be distorted.

The number of exploratory wells in the U.S. had a profound influence on price. Although no World exploratory well data could be located, the strong U.S. correlation should convince us to redouble our efforts to locate data for this potentially important global factor.

As expected, OPEC market share had a strong correlation to crude oil price. Also, the Reserve/ Production ratio and the Production/Refining Capacity ratio had the most influence on petroleum prices for both models. Our logic concerning the effects of a relative scarcity of reserves compared to production levels and the relative scarcity of refining capacity compared to production levels seems to be borne out.



Finally, the "special events" factor appeared to have no correlation to crude oil price for either model. Our crude magnitude effect modeling attempt was ineffective at capturing the effects of extraordinary and significant events. A better model must be devised and tested since "special events" most assuredly impact prices.

Multiple Regression Analysis: After eliminating those factors which had negligible effects on price (red high-lights in **Figure XI**), a multiple regression analysis was performed on all remaining factors and their derivatives. One problem encountered was the differing time periods covered by different factor data series. For example, production data ran from 1970 to 1998 while exploratory well data ran from 1972 to 1998. In order to combine different factor data series into a single regression analysis, an identical number of data points had to be used for each factor. Thus, the factor data series with the fewest number of data points became the limiting element determining which data was ultimately used. In the example above, if both production and exploratory well data were included in a multiple regression analysis, data would be constrained to the inclusive period from 1972 through 1998. If refining capacity data were also included then the overall analysis would be limited to the period from 1972 through 1990. Utilizing a mere 19 data points begins to generate difficulties when used as a basis for generating significant statistical results. This also undermines our intention of using a long time interval to base our modeling efforts upon. The only viable solution is to obtain more complete and higher quality data which completely covers all time periods of interest. Such data was not available for this analysis and any conclusion drawn from continued analysis must keep this limitation in mind.

Multiple Regression Results: Several different regression runs were made using combinations of factors giving ever smaller inclusive periods of data coverage (1970-1998, 1972-1998, 1972-1990,). Surprisingly, the resulting factors which had a significant price influence remained largely unchanged as the model period was truncated to include more factors. The best results came from regression runs which used all of the factors and thus had the shortest inclusive data period (1972-1990). The U.S. and World multiple regression results are shown below:

U.S. Model

Overall R-Squared = 98%

Factor	P-Value
SQGDP	**0.002**
LN1USEW	**0.000**
1RPR	**0.004**
PRCR	**0.006**
SQPRCR	**0.009**
GDPGR	**0.017**

World Model

Overall R-Squared = 94.7%

Factor	P-Value
SQGDP	**0.004**
1PR	**0.002**
PRCR	**0.077**
OPEC	**0.000**
LNOPEC	**0.000**
GDP	**0.003**

U.S. PRICE = 109 + 0.668 (SQGDP) – 46.3 (LN1USEW) – 471 (1RPR) – 715 (PRCR) + 910 (SQPRCR) – 73 (GDPGR)

WORLD PRICE = -1684 + 0.365 (SQGDP) + 79.2 (1PR) – 69.6 (PRCR) –18.6 (OPEC) + 670 (LNOPEC) –10.2 (GDP)

The actual coefficients resulting from the regression analysis were not important. What was important was that six U.S. factors and six World factors were identified as having a significant influence on price (low P-values) as well as being able to explain 94.7%-98% of price when their effects were combined. The amount of price variation which could be explained by these factors (94.7%-98%) was surprising given that this was our first modeling attempt.

Stage V: Conclusion

Assumptions and Limitations: Before recounting and consolidating the results of this Part-I analysis, it is prudent to review the assumptions made and associated limitations placed upon those results.

- The Part-I analysis was an attempt to identify factors which had a measurable impact on crude oil price. Once identified, these factors could then be examined more carefully (in the Part-II analysis) to create a model which could be used to predict general price levels. It was assumed that the petroleum market could be conveniently captured through the concept of aggregate macro-economic factors and that such factors could be easily combined with a global or U.S. wide scope. The great simplification was that the market was entirely homogeneous and that differences in geography, national borders, language, culture, currency, politics, regulation, economic goals and collusion did not exist. This is obviously not the case. The incredible difficulty of trying to account for the myriad complexities and interactions left no choice but to paint with a broad brush. This modeling effort was never intended to predict daily, weekly or even monthly price variations. Such predictions are simply impossible given the complexities involved and the random and unpredictable nature of daily events.

- We assumed that there was one single representative market price for one single type of representative crude oil. In fact there are many variations in the quality and composition of crude oils and even wider variations in the price of such oils throughout the world. The assumption more practically asserts, that although no single price actually exists, all of the various prices for various crude oils will respond in similar and proportional ways to the forces shaping the supply and demand for petroleum energy.

- Inventory levels and inventory build-ups and draw-downs were ignored as being of small influence when compared to aggregate annual production and consumption volumes.

- Taxes, tariffs, quotas, currency exchange rates, price controls and individual price off-sets were ignored; especially as they pertained to regional differences.

- The effect of periodic weather changes was ignored.

- Gross crude oil production was assumed a good proxy for total petroleum supply. Secondary sources were considered negligible.

- The geophysical characteristics of individual reservoirs was ignored.

- The U.S. Strategic Petroleum Reserve was ignored.

• The current petroleum era was taken to be 1970-1998. It was assumed to be homogeneous in terms of the forces shaping the petroleum industry. In fact, the petroleum industry has never experienced a period of homogeneity. It has been in constant flux and continues to experience change in technology, regulation, and political and economic influences and may never be able to be modeled as a simple, consistent and homogeneous event for any substantial time frame.

• The statistical analysis capabilities and experience of the author are limited and should not be construed as being comprehensive or exhaustive.

• The data is severely limited. Numerous problems with the quality, quantity and availability of aggregate data make results suspect.

• The time-lag associated with any key factor's influence on price was ignored.

• The use of factor derivatives such as logarithms and squares is by no means exhaustive. It was simply an attempt to see if any type of non-linear relationship might exist. There are an infinite number of mathematical functions available (square root, cubes, ARCTAN, etc) which might prove to better represent the influence of a factor on price.

• The use of aggregate factors or proxy factors using data that was freely available was employed to construct an empirical model. There is no grand theoretical model on which to base our efforts although much of our reasoning was loosely tied to economic supply-demand theory.

Results: Using individual and multiple regression analysis for U.S. and global petroleum market data indicated that the following factors had a strong influence on crude oil price (strongest to weakest):

Production/Refining Capacity Ratio
Non-linear derivative of Production/Refining Capacity Ratio
Reserve/Production Ratio
Non-linear derivative of the Number of Exploratory Wells
OPEC Market Share
Non-linear derivative of OPEC Market Share
Non-linear derivative of GDP
GDP
GDP Growth Rate
Crude oil production levels
Proved Reserve levels

Not only were important factors which influence crude oil prices identified, this process also eliminated several factors which were initially under consideration as having potential influence.

Recommendations: After attacking this thesis project for many months it is now apparent that considerable more time and effort will be required to complete the job adequately.

- I suggest revisiting the numerous modeling efforts made by other academic and industrial scientists in greater detail. Each of these books/studies/reports may be able to provide new insights into the past failures and point the project in a more productive direction. With over 2,000 references at the University of Kansas alone, there simply hasn't been sufficient time to thoroughly review these works and develop a comprehensive knowledge base on the petroleum market modeling subject. I am confident that a good start has been made and that the factors identified above can be useful in constructing an empirical model in the Part-II analysis. There simply hasn't been time to pursue this project further and this project was probably better suited to a 3-4 PhD program vice a 3 credit hour thesis project.

- A better quantitative model must be developed to capture the effects of extraordinary and significant events which most assuredly have an impact on price. The crude model used in this analysis was inadequate. Perhaps assigning event magnitudes which are proportional to the maximum price percentage increase for the event would prove more effective.

- The Oil Energy Use Ratio did not have significant impact on oil prices and a better factor or combination of factors must be developed to capture the effects of alternative energy sources on oil prices. Correlating key factors pertaining to natural gas, coal, hydroelectric power, nuclear power etcetera may provide better results and more fully capture the effects of alternative energy sources. The time-lag effect of changes in alternative energy sources and pricing impacts must also be explored.

- The breadth and quality of data must be vastly improved. I feel that this can only be accomplished through the purchase of highly reliable data from an authoritative source (API). This will also improve the sheer number of data points used and minimize the errors caused by using relatively small data sets. Department of Commerce data consisting of numerous leading economic indicators is another place to locate additional factors which may correlate to price.

- Instead of choosing a single crude oil price (Saudi Light 34, for example) as our representative price, perhaps we should consider calculating a weighted market average price, aggregating the price and volume information for each crude oil product produced in a given year. Although such a price would be substantially more representative of an overall global price, I fear that data availability may limit the usefulness of this approach.

- A method of quantifying environmental impacts should be attempted.

- Annual aggregate data may be too course of a measuring stick to adequately capture the qualitative forces (extraordinary and significant events) which influence price. Such events are of a short duration and perhaps daily or monthly data should be used in lieu of aggregate annual data. I am not sure if such data is even available but it may be the only way to gain sufficient sensitivity to account for the qualitative forces impacting price.

- Inventory levels including the Strategic Petroleum Reserve (SPR) should be correlated with price to see if any influence on price is evident.

- The time-lag effects of exploratory well drilling should be explored and global well drilling data should be obtained and incorporated into the model.

Bring additional petroleum and mathematical modeling expertise into the project. More minds brainstorming possible approaches to developing correlations will produce better results. Additionally, different combinations of non-linear factor derivatives should be tried to identify an optimal non-linear relationship for each factor.

Final Thoughts: The Part-I analysis must continue in an effort to acquire better data, identify additional important factors of influence and to develop more sophisticated factor-models before a refined model attempt (Part-II analysis) can be made. This analysis was able to make substantial progress into understanding the forces influencing crude oil price, understanding the assumptions and limitations associated with a macro-economic approach and in identifying several key factors which demonstrated a significant correlation to price.

Year	U.S. Proved Reserves (MMMbbls)	1/USPR	LN of 1USPR	Square of 1USPR (x 1000)	U.S. Reserve/ Production Ratio	1/USRPR	LN of 1USRPR	Square of 1USRPR (x 1000)
CODE	USPR	1USPR	LN1USPR	SQ1USPR	USRPR	1USRPR	LN1USRPR	SQ1USRPR
1970	39.001	0.0256	-3.6652	0.6554	11.088	0.09019	-2.406	8.134
1971	38.063	0.0263	-3.6382	0.6917	11.020	0.09074	-2.400	8.234
1972	36.339	0.0275	-3.5936	0.7563	10.517	0.09508	-2.353	9.040
1973	35.300	0.0283	-3.5649	0.8009	10.503	0.09521	-2.352	9.065
1974	34.250	0.0292	-3.5336	0.8526	10.694	0.09351	-2.370	8.744
1975	32.682	0.0306	-3.4868	0.9364	10.692	0.09353	-2.369	8.748
1976	30.942	0.0323	-3.4327	1.0433	10.397	0.09618	-2.342	9.251
1977	29.486	0.0339	-3.3843	1.1492	9.798	0.10206	-2.282	10.416
1978	27.804	0.0360	-3.3242	1.2960	8.748	0.11431	-2.169	13.067
1979	29.810	0.0335	-3.3962	1.1222	9.550	0.10471	-2.257	10.964
1980	29.805	0.0336	-3.3932	1.1290	9.472	0.10557	-2.248	11.145
1981	29.426	0.0340	-3.3814	1.1560	9.405	0.10633	-2.241	11.306
1982	27.858	0.0359	-3.3270	1.2888	8.825	0.11331	-2.178	12.839
1983	27.735	0.0361	-3.3215	1.3032	8.746	0.11434	-2.169	13.074
1984	28.446	0.0352	-3.3467	1.2390	8.753	0.11425	-2.169	13.053
1985	28.416	0.0352	-3.3467	1.2390	8.678	0.11523	-2.161	13.278
1986	26.889	0.0372	-3.2914	1.3838	8.487	0.11178	-2.191	12.495
1987	27.256	0.0367	-3.3050	1.3469	8.926	0.11203	-2.189	12.551
1988	26.825	0.0373	-3.2888	1.3913	8.992	0.11121	-2.196	12.368
1989	26.501	0.0377	-3.2781	1.4213	9.520	0.10504	-2.253	11.033
1990	26.254	0.0381	-3.2675	1.4516	9.743	0.10264	-2.277	10.535
1991	24.682	0.0405	-3.2065	1.6403	9.103	0.10985	-2.209	12.067
1992	23.745	0.0421	-3.1677	1.7724	9.037	0.11066	-2.201	12.246
1993	22.957	0.0436	-3.1327	1.9010	9.139	0.10942	-2.213	11.973
1994	22.457	0.0445	-3.1123	1.9803	9.228	0.10837	-2.222	11.744
1995	22.351	0.0447	-3.1078	1.9981	9.291	0.10763	-2.229	11.584
1996	22.017	0.0454	-3.0922	2.0612	9.265	0.10793	-2.226	11.649
1997	22.546	0.0444	-3.1145	1.9714	9.574	0.10445	-2.259	10.910
1998					0.000			0.000

Exhibit I
U.S. TABLE4

Year	U.S. Crude Oil Production (MMMbbls)	1/USPROD	LN of 1USPROD	Square of 1USPROD	U.S. Oil Use (10^{12} BTUs)	U.S. Total Energy Use (10^{12} BTUs)	Oil Energy Use Ratio	LN of Oil Energy Use Ratio	Square of Oil Energy Use Ratio
CODE	USPROD	1USPROD	LN1USPROD	SQ1USPROD			USOEUR	LNUSOEUR	SQUSOEUR
1970	3.51745	0.28430	-1.2577	0.08083	29537	67143	0.440	-0.821	0.1936
1971	3.453914	0.28953	-1.2395	0.08383	30570	68348	0.447	-0.805	0.1998
1972	3.455368	0.28940	-1.2399	0.08375	32966	71643	0.460	-0.777	0.2116
1973	3.360903	0.29754	-1.2122	0.08853	34840	74282	0.469	-0.757	0.2120
1974	3.202585	0.31225	-1.1640	0.09750	33455	72543	0.461	-0.774	0.2125
1975	3.056779	0.32714	-1.1174	0.10702	32731	70546	0.464	-0.768	0.2153
1976	2.97618	0.33600	-1.0906	0.11290	35175	74362	0.473	-0.749	0.2237
1977	3.009265	0.32335	-1.1290	0.10456	37122	76288	0.487	-0.719	0.2372
1978	3.178216	0.31464	-1.1563	0.09900	37965	78089	0.486	-0.722	0.2362
1979	3.12131	0.32038	-1.1382	0.10264	37123	78898	0.471	-0.753	0.2218
1980	3.146519	0.31781	-1.1463	0.10100	34202	75955	0.450	-0.799	0.2025
1981	3.128624	0.31963	-1.1406	0.10216	31931	73990	0.432	-0.839	0.1866
1982	3.156715	0.31679	-1.1495	0.10036	30231	70848	0.427	-0.851	0.1823
1983	3.170999	0.31536	-1.1540	0.09945	30054	70524	0.426	-0.853	0.1815
1984	3.249696	0.30772	-1.1786	0.09469	31051	74144	0.419	-0.870	0.1756
1985	3.274553	0.30538	-1.1862	0.09326	30922	73981	0.418	-0.872	0.1747
1986	3.168252	0.31563	-1.1532	0.09962	32196	74297	0.433	-0.837	0.1875
1987	3.053488	0.32749	-1.1163	0.10725	32865	76894	0.427	-0.851	0.1823
1988	2.983172	0.33521	-1.0930	0.11237	34222	80218	0.427	-0.851	0.1823
1989	2.783588	0.35925	-1.0237	0.12906	34211	81358	0.420	-0.868	0.1764
1990	2.694517	0.37112	-0.9912	0.13773	33553	81283	0.413	-0.884	0.1706
1991	2.711415	0.36881	-0.9975	0.13602	32845	81138	0.405	-0.904	0.1640
1992	2.627654	0.38057	-0.9661	0.14483	33527	82154	0.408	-0.896	0.1665
1993	2.511959	0.39810	-0.9211	0.15848	33841	83871	0.403	-0.909	0.1624
1994	2.433643	0.41091	-0.8894	0.16885	34735	85598	0.406	-0.901	0.1648
1995	2.4056	0.41570	-0.8778	0.17281	34663	87205	0.397	-0.924	0.1576
1996	2.376444	0.42080	-0.8656	0.17707	35864	90041	0.398	-0.921	0.1584
1997	2.354831	0.42466	-0.8565	0.18034	36381	90698	0.401	-0.914	0.1608
1998	2.281919	0.43823	-0.8250	0.19205	36610	91250	0.401	-0.914	0.1608

Exhibit I
U.S. TABLE3

Year	U.S. GDP ($ Trillions)	LN of U.S. GDP	Square of U.S. GDP	U.S. GDP Growth Rate (%)	LN of U.S. GDP Growth Rate	Square of U.S. GDP Growth Rate (x 1000)	Exploratory Wells in U.S. (1000s)	1/USEW	LN 1USEW	Square of 1USEW
CODE	USGDP	LNUSGDP	USGDPSQ	USGDPGR	LNUSGDPGR	SQUSGDPGR	USEW	1USEW	LN1USEW	SQ1USEW
1970	1.0089	0.0089	1.0179	0.00%						
1971	1.0961	0.0918	1.2014	8.64%	-2.4488	7.4650				
1972	1.2058	0.1871	1.4540	10.01%	-2.3016	10.0200	7.551	0.1324	-2.022	0.01753
1973	1.3483	0.2988	1.8179	11.82%	-2.1354	13.9700	7.771	0.1287	-2.050	0.01656
1974	1.4576	0.3768	2.1246	8.11%	-2.5121	6.5770	8.969	0.1115	-2.194	0.01243
1975	1.5855	0.4609	2.5138	8.77%	-2.4338	7.6910	9.459	0.1057	-2.247	0.01117
1976	1.7714	0.5718	3.1379	11.73%	-2.1430	13.7600	9.317	0.1073	-2.232	0.01151
1977	1.9738	0.6800	3.8959	11.43%	-2.1689	13.0600	10.14	0.0986	-2.317	0.00972
1978	2.2290	0.8016	4.9684	12.93%	-2.0456	16.7200	11.03	0.0907	-2.400	0.00823
1979	2.4880	0.9115	6.1901	11.62%	-2.1524	13.5000	10.735	0.0932	-2.373	0.00869
1980	2.7090	0.9966	7.3387	8.88%	-2.4214	7.8850	12.87	0.0777	-2.555	0.00604
1981	3.0393	1.1116	9.2373	12.19%	-2.1046	14.8600	17.43	0.0574	-2.858	0.00329
1982	3.1589	1.1502	9.9786	3.94%	-3.2340	1.5520	15.882	0.063	-2.765	0.00397
1983	3.4129	1.2276	11.6480	8.04%	-2.5207	6.4640	13.845	0.0722	-2.628	0.00521
1984	3.7864	1.3314	14.3370	10.94%	-2.2127	1.1970	15.138	0.0661	-2.717	0.00437
1985	4.0482	1.3983	16.3880	6.91%	-2.6722	4.7750	12.208	0.0819	-2.502	0.00671
1986	4.2681	1.4512	18.2170	5.43%	-2.9132	2.9480	7.156	0.1397	-1.968	0.01952
1987	4.5281	1.5103	20.5040	6.09%	-2.7985	3.7090	6.903	0.1449	-1.932	0.02100
1988	4.8788	1.5849	23.8030	7.74%	-2.5588	5.9910	6.35	0.1575	-1.848	0.02481
1989	5.2609	1.6603	27.6770	7.83%	-2.5472	6.1310	5.335	0.1874	-1.675	0.03512
1990	5.5541	1.7145	30.8480	5.57%	-2.8878	3.1020	5.133	0.1948	-1.636	0.03795
1991	5.7109	1.7424	32.6140	2.82%	-3.5684	0.7952	4.443	0.2251	-1.491	0.05067
1992	6.0277	1.7964	36.3330	5.55%	-2.8914	3.0800	3.467	0.2884	-1.243	0.08317
1993	6.3417	1.8471	40.2170	5.21%	-2.9546	2.7140	3.583	0.2791	-1.276	0.07790
1994	6.7229	1.9055	45.1970	6.01%	-2.8117	3.6120	3.76	0.266	-1.324	0.07076
1995	7.0336	1.9507	49.4720	4.62%	-3.0748	2.1340	3.386	0.2953	-1.220	0.08720
1996	7.3906	2.0002	54.6210	5.08%	-2.9799	2.5810	3.308	0.3023	-1.196	0.09139
1997	7.8233	2.0571	61.2040	5.85%	-2.8387	3.4220	3.236	0.309	-1.174	0.09548
1998	8.2106	2.1054	67.4140	4.95%	-3.0058	2.4500	2.586	0.3867	-0.950	0.14954

Exhibit I
U.S. TABLE2

Year	U.S. Domestic First Purchase Price ($/bbl) (1999 $)	U.S. Price/Price Ratio	LN of Price/Price Ratio	Square of Price/Price Ratio	U.S. Population (Millions)	LN of U.S. Population	Square of U.S. Population	U.S. Population Growth Rate (%)	LN of U.S. Population Growth Rate	Square of U.S. Population Growth Rate (x 1000)
CODE	USP	USPPR	LNUSPPR	USPPRSQ	USPOP	LNUSPOP	USPOPSQ	USPOPGR	LNUSPOPGR	USPOPGRSQ
1970	$13.71				205.05	5.3233	42045	0.00%		
1971	$13.95	1.02	0.0198	1.0404	207.66	5.3359	43123	1.27%	-4.3662	0.1613
1972	$13.56	0.97	-0.0305	0.9409	209.90	5.3466	44058	1.08%	-4.5282	0.1166
1973	$14.62	1.08	0.0770	1.1664	211.91	5.3562	44906	0.96%	-4.6460	0.0922
1974	$23.29	1.59	0.4637	2.5281	213.85	5.3653	45732	0.92%	-4.6886	0.0846
1975	$23.82	1.02	0.0198	1.0404	215.97	5.3751	46643	0.99%	-4.6152	0.0980
1976	$24.02	1.01	0.0100	1.0201	218.04	5.3847	47541	0.96%	-4.6460	0.0922
1977	$23.61	0.98	-0.0202	0.9604	220.24	5.3947	48506	1.01%	-4.5952	0.1020
1978	$23.08	0.98	-0.0202	0.9604	222.58	5.4053	49542	1.06%	-4.5469	0.1124
1979	$29.06	1.26	0.2311	1.5876	225.06	5.4164	50652	1.11%	-4.5008	0.1232
1980	$43.79	1.51	0.4121	2.2801	227.22	5.4259	51629	0.96%	-4.6460	0.0922
1981	$58.40	1.33	0.2852	1.7689	229.47	5.4358	52656	0.99%	-4.6152	0.0980
1982	$49.34	0.84	-0.1744	0.7056	231.66	5.4453	53666	0.95%	-4.6565	0.0903
1983	$43.94	0.89	-0.1165	0.7921	233.79	5.4544	54658	0.92%	-4.6886	0.0846
1984	$41.61	0.95	-0.0513	0.9025	235.82	5.4631	55611	0.87%	-4.7444	0.0757
1985	$37.41	0.90	-0.1054	0.8100	237.92	5.4719	56606	0.89%	-4.7217	0.0792
1986	$19.07	0.51	-0.6733	0.2601	240.13	5.4812	57662	0.93%	-4.6778	0.0865
1987	$22.65	1.19	0.1740	1.4161	242.29	5.4901	58704	0.90%	-4.7105	0.0810
1988	$17.77	0.78	-0.2485	0.6084	244.50	5.4992	59780	0.91%	-4.6994	0.0828
1989	$21.35	1.20	0.1823	1.4400	246.82	5.5087	60920	0.95%	-4.6565	0.0903
1990	$25.58	1.20	0.1823	1.4400	249.44	5.5192	62220	1.06%	-4.5469	0.1124
1991	$20.27	0.79	-0.2357	0.6241	252.12	5.5299	63564	1.07%	-4.5375	0.1145
1992	$19.04	0.94	-0.0619	0.8836	255.00	5.5413	65025	1.14%	-4.4741	0.1230
1993	$16.47	0.87	-0.1393	0.7569	257.75	5.552	66435	1.08%	-4.5282	0.1166
1994	$14.87	0.90	-0.1054	0.8100	260.29	5.5618	67751	0.99%	-4.6152	0.0980
1995	$16.01	1.08	0.0770	1.1664	262.76	5.5712	69043	0.95%	-4.6565	0.0903
1996	$19.64	1.23	0.2070	1.5129	265.18	5.5804	70320	0.92%	-4.6886	0.0846
1997	$17.93	0.91	-0.0943	0.8281	267.64	5.5896	71631	0.93%	-4.6778	0.0865
1998	$11.15	0.62	-0.4780	0.3844	270.03	5.5985	72916	0.89%	-4.7217	0.0792

Exhibit I
U.S. TABLE1

Year	U.S. Refining Capacity (MMMbbls)	Production/ Refining Capacity Ratio	LN of U.S. Production/ Rrefining Capacity Ratio	Square of U.S. Production/ Refing Capacity Ratio
CODE		USPRCR	LNUSPRCR	SQUSPRCR
1970	9.07828	0.387	-0.950	0.150
1971	7.54857	0.458	-0.781	0.210
1972	7.70442	0.448	-0.803	0.201
1973	7.72815	0.435	-0.832	0.189
1974	7.80881	0.410	-0.892	0.168
1975	8.23221	0.371	-0.992	0.138
1976	8.9279	0.333	-1.010	0.111
1977	8.98557	0.335	-1.094	0.112
1978	9.66374	0.329	-1.112	0.108
1979	9.66082	0.323	-1.130	0.104
1980	9.9291	0.317	-1.149	0.100
1981	10.5485	0.297	-1.214	0.088
1982	9.75463	0.324	-1.127	0.105
1983	9.17647	0.346	-1.061	0.120
1984	9.18267	0.354	-1.038	0.125
1985	9.42722	0.347	-1.058	0.120
1986	9.49438	0.334	-1.097	0.112
1987	9.37539	0.326	-1.121	0.106
1988	9.71192	0.307	-1.181	0.094
1989	9.96815	0.279	-1.277	0.078
1990	9.80536	0.275	-1.291	0.076
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998				

Exhibit I
U.S. TABLE5

Year	Arabian Light (34) ($/bbl) (1999 $)	World Price/Price Ratio	LN of Price/Price Ratio	Square of Price/Price Ratio	World Population (Trillions)	LN of World Population	Square of World Population	World Population Growth Rate (%)	LN of World Population Growth Rate	Square of World Population Growth Rate (x 1000)
CODE	WP	WPPR	LNWPPR	SQWPPR	WPOP	LNWPOP	SQWPOP	WPOPGR	LNWPOPGR	SQWPOPGR
1970	$5.82				3.67597	1.3018	13.5128	0.00%		
1971	$7.20	1.24	0.215	1.5376	3.75423	1.3229	14.0942	2.13%	-3.8490	0.4537
1972	$7.60	1.06	0.058	1.1236	3.83119	1.3432	14.6780	2.05%	-3.8873	0.4203
1973	$7.89	1.04	0.039	1.0816	3.90738	1.3629	15.2676	1.99%	-3.9170	0.3960
1974	$32.54	4.12	1.416	16.9744	3.98418	1.3823	15.8737	1.97%	-3.9271	0.3881
1975	$32.48	1.00	0.000	1.0000	4.05942	1.4010	16.4789	1.89%	-3.9686	0.3572
1976	$33.75	1.04	0.039	1.0816	4.13228	1.4188	17.0757	1.79%	-4.0230	0.3204
1977	$33.31	0.99	-0.010	0.9801	4.20514	1.4363	17.6832	1.76%	-4.0399	0.3098
1978	$32.56	0.98	-0.020	0.9604	4.27891	1.4537	18.3091	1.75%	-4.0456	0.3063
1979	$30.67	0.94	-0.062	0.8836	4.35424	1.4712	18.9594	1.76%	-4.0399	0.3098
1980	$52.74	1.72	0.542	2.9584	4.42987	1.4884	19.6237	1.74%	-4.0513	0.3028
1981	$58.82	1.16	0.148	1.3456	4.50608	1.5054	20.3048	1.72%	-4.0628	0.2958
1982	$58.82	1.00	0.000	1.0000	4.58485	1.5228	21.0209	1.75%	-4.0456	0.3063
1983	$57.05	0.97	-0.030	0.9409	4.66465	1.5400	21.7590	1.74%	-4.0513	0.3028
1984	$46.62	0.82	-0.198	0.6724	4.74283	1.5566	22.4944	1.68%	-4.0864	0.2822
1985	$45.03	0.97	-0.030	0.9409	4.82298	1.5734	23.2611	1.69%	-4.0804	0.2856
1986	$42.68	0.95	-0.051	0.9025	4.90715	1.5907	24.0801	1.75%	-4.0456	0.3063
1987	$23.75	0.56	-0.580	0.3136	4.99315	1.6081	24.9315	1.75%	-4.0456	0.3063
1988	$24.75	1.04	0.039	1.0816	5.08019	1.6253	25.8083	1.74%	-4.0513	0.3028
1989	$17.70	0.72	-0.329	0.5184	5.16778	1.6424	26.7060	1.72%	-4.0628	0.2958
1990	$23.50	1.33	0.285	1.7689	5.25661	1.6595	27.6319	1.72%	-4.0628	0.2958
1991	$29.41	1.25	0.223	1.5625	5.34225	1.6756	28.5396	1.63%	-4.1166	0.2657
1992	$18.93	0.64	-0.446	0.4096	5.42392	1.6908	29.4189	1.53%	-4.1799	0.2341
1993	$19.42	1.03	0.030	1.0609	5.5015	1.7050	30.2665	1.43%	-4.2475	0.2045
1994	$13.98	0.72	-0.329	0.5184	5.57868	1.7190	31.1217	1.40%	-4.2687	0.1960
1995	$18.21	1.30	0.262	1.6900	5.65725	1.7329	32.0045	1.41%	-4.2616	0.1988
1996	$19.36	1.06	0.058	1.1236	5.7366	1.7469	32.9086	1.40%	-4.2687	0.1960
1997	$23.91	1.24	0.215	1.5376	5.81822	1.7610	33.8517	1.42%	-4.2545	0.2016
1998	$15.88	0.66	-0.416	0.4356	5.89652	1.7744	34.7689	1.35%	-4.3051	0.1823

Exhibit II
WORLD TABLE1

Year	World GDP ($ Trillions)	LN of World GDP	Square of World GDP	World GDP Growth Rate (%)	Square of World GDP Growth Rate (x 1000)	World Crude Oil Production (MMMbbls)	1/WPROD	LN of 1WPROD	Square of 1WPROD (x 1000)
CODE	WGDP	LNWGDP	SQWGDP	WGDPGR	SQWGDPGR	WPROD	1WPROD	LN1PROD	SQ1WPROD
1970	2.4766	0.9069	6.1335	0.00%		16.679254	0.05995	-2.8142	3.5940
1971	2.7252	1.0025	7.4267	10.04%	10.080	17.647152	0.05667	-2.8705	3.2115
1972	3.1415	1.1447	9.8690	15.28%	23.350	18.601065	0.05376	-2.9232	2.8901
1973	3.8216	1.3407	14.6046	21.65%	46.870	20.376295	0.04908	-3.0143	2.4088
1974	4.4304	1.4885	19.6284	15.93%	25.380	20.424849	0.04896	-3.0168	2.3117
1975	4.9535	1.6001	24.5372	11.81%	13.950	19.333022	0.05173	-2.9617	2.6760
1976	5.3565	1.6783	28.6921	8.14%	6.626	20.997179	0.04763	-3.0443	2.2686
1977	6.0754	1.8042	36.9105	13.42%	18.010	21.752317	0.04600	-3.0791	2.1160
1978	7.1484	1.9669	51.0996	17.66%	31.190	21.869627	0.04573	-3.0850	2.0912
1979	8.2883	2.1148	68.6959	15.95%	25.440	22.767026	0.04392	-3.1254	1.9290
1980	9.497	2.2510	90.1930	14.58%	21.260	21.709521	0.04606	-3.0778	2.1215
1981	9.8945	2.2920	97.9011	4.19%	1.756	20.347915	0.04915	-3.0129	2.4157
1982	9.7251	2.2747	94.5776	-1.71%	-0.292	19.518221	0.05123	-2.9714	2.6245
1983	9.9893	2.3015	99.7861	2.72%	0.740	19.430663	0.05147	-2.9668	2.6492
1984	10.4882	2.3503	110.0023	4.99%	2.490	19.945536	0.05014	-2.9929	2.5140
1985	10.9765	2.3958	120.4836	4.66%	2.172	19.703492	0.05075	-2.9808	2.5756
1986	12.799	2.5494	163.8144	16.60%	27.560	20.522809	0.04873	-3.0215	2.3746
1987	14.6505	2.6845	214.6372	14.47%	20.940	20.689557	0.04833	-3.0297	2.3358
1988	16.4305	2.7991	269.9613	12.15%	14.760	21.500631	0.04651	-3.0681	2.1632
1989	17.8827	2.8838	319.7910	8.84%	7.815	21.855119	0.04576	-3.0843	2.0940
1990	19.6644	2.9788	386.6886	9.96%	9.920	22.116676	0.04521	-3.0964	2.0439
1991	22.1203	3.0965	489.9308	12.49%	15.600	21.979939	0.04550	-3.0900	2.0703
1992	23.5984	3.1612	556.8845	6.68%	4.462	22.040636	0.04537	-3.0929	2.0584
1993	23.9407	3.1756	573.1571	1.45%	0.210	22.003424	0.04545	-3.0911	2.0657
1994	25.745	3.2482	662.8050	7.54%	5.685	22.271039	0.04490	-3.1033	2.0160
1995	28.4131	3.3469	807.3043	10.36%	10.730	22.80549	0.04385	-3.1270	1.9228
1996	28.8995	3.3638	835.1811	1.71%	0.292	23.459393	0.04263	-3.1552	1.8173
1997	28.6208	3.3541	819.1502	-0.96%	-0.093	24.319058	0.04112	-3.1913	1.6909
1998	27.2525	3.3051	742.6988	-4.78%	-2.285	27.485	0.03638	-3.3137	1.3235

Exhibit II
WORLD TABLE2

Year	World Oil Use (10^{12} BTUs)	World Total Energy Use (10^{12} BTUs)	World Oil Energy Use Ratio	LN of Oil Energy Use Ratio	Square of Oil Energy Use Ratio	World Proved Reserves (MMMbbls)	1/WPR (x 1000)	LN of 1WPR	Square of 1WPR
CODE			WEUR	LNWEUR	SQWEUR	WPR	1WPR	LN1WPR	SQ1WPR
1970						611.4	1.6356	0.4920	2.6752
1971						631.8	1.5828	0.4592	2.5053
1972						666.9	1.4995	0.4051	2.2485
1973	117,880	246,860	0.47752	-0.73915	0.22803	627.9	1.5926	0.4654	2.5364
1974	117,820	249,570	0.47209	-0.75058	0.22287	615.7	1.6242	0.4850	2.6380
1975	113,090	248,700	0.45472	-0.78806	0.20677	658.7	1.5181	0.4175	2.3046
1976	122,920	262,490	0.46828	-0.75868	0.21929	598.9	1.6697	0.5126	2.7879
1977	127,750	271,210	0.47104	-0.75282	0.22188	645.8	1.5485	0.4373	2.3979
1978	128,510	276,910	0.46409	-0.76769	0.21538	641.6	1.5586	0.4438	2.4292
1979	133,870	291,700	0.45893	-0.77886	0.21062	641.6	1.5586	0.4438	2.4292
1980	128,120	284,760	0.44992	-0.79868	0.20243	648.5	1.5420	0.4331	2.3778
1981	120,160	279,350	0.43014	-0.84364	0.18502	670.7	1.4910	0.3994	2.2231
1982	114,510	276,110	0.41473	-0.88014	0.17200	670.2	1.4921	0.4002	2.2264
1983	113,970	279,710	0.40746	-0.89782	0.16602	669.3	1.4941	0.4015	2.2323
1984	116,860	295,440	0.39555	-0.92749	0.15646	698.7	1.4312	0.3585	2.0483
1985	115,400	303,210	0.38059	-0.96602	0.14485	700.1	1.4284	0.3566	2.0403
1986	120,240	312,980	0.38418	-0.95665	0.14759	697.4	1.4339	0.3604	2.0561
1987	121,160	320,420	0.37813	-0.97252	0.14298	887.3	1.1270	0.1196	1.2701
1988	125,930	332,730	0.37848	-0.97161	0.14325	907.4	1.1020	0.0971	1.2144
1989	127,980	339,050	0.37747	-0.97427	0.14248	961.7	1.0398	0.0390	1.0812
1990	129,500	347,770	0.37237	-0.98786	0.13866	999.1	1.0009	0.0009	1.0018
1991	128,770	344,800	0.37346	-0.98494	0.13947	999.1	1.0009	0.0009	1.0018
1992	129,130	347,020	0.37211	-0.98856	0.13847	997.0	1.0030	0.0030	1.0060
1993	128,860	348,740	0.36950	-0.99560	0.13653	997.0	1.0030	0.0030	1.0060
1994	130,460	353,910	0.36962	-0.99798	0.13662	999.1	1.0009	0.0009	1.0018
1995	133,320	364,670	0.36559	-1.00624	0.13366	1,000.0	1.0000	0.0000	1.0000
1996	137,390	375,110	0.36627	-1.00440	0.13415	1,007.5	0.9926	-0.0074	0.9853
1997						1,018.8	0.9815	-0.0187	0.9633
1998						1,019.5	0.9809	-0.0193	0.9622

Exhibit II
WORLD TABLE3

Year	World Reserve/ Production Ratio	1/WRPR	LN of 1WRPR	Square of 1WRPR (x 1000)	World Refining Capacity (MMMbbls)	Production/ Refining Capacity Ratio	LN of World Production/ Refining Capacity Ratio	Square of World Production/ Refining Capacity Ratio	OPEC Market Share (%)	LN of Opec Market Share	Square of OPEC Market Share
CODE	WRPR	1WRPR	LN1WRPR	SQ1WRPR		WPRCR	LNWPRCR	SQWPRCPR	OMS	LNOMS	SQOMS
1970	36.66	0.0273	-3.602	0.7453	24.729	0.67448	-0.39381	0.45492	51.0	3.932	2601
1971	35.80	0.0279	-3.578	0.7784	23.182	0.76124	-0.27281	0.57949	52.2	3.955	2725
1972	35.85	0.0279	-3.579	0.7784	23.952	0.77660	-0.25283	0.60311	52.9	3.968	2798
1973	30.81	0.0325	-3.428	1.0563	24.771	0.82259	-0.19530	0.67665	54.9	4.006	3014
1974	30.14	0.0332	-3.406	1.1022	25.657	0.79607	-0.22807	0.63373	54.3	3.995	2948
1975	34.07	0.0294	-3.528	0.8644	26.944	0.71753	-0.33194	0.51485	50.6	3.924	2560
1976	28.52	0.0351	-3.351	1.2320	33.146	0.63348	-0.45653	0.40130	52.9	3.968	2798
1977	29.69	0.0337	-3.391	1.1357	33.864	0.64234	-0.44264	0.41260	50.5	3.922	2550
1978	29.34	0.0341	-3.379	1.1628	35.721	0.61223	-0.49065	0.37483	49.1	3.894	2411
1979	28.18	0.0355	-3.339	1.2603	35.829	0.63544	-0.45344	0.40378	48.9	3.890	2391
1980	29.87	0.0335	-3.397	1.1223	36.662	0.59215	-0.52400	0.35064	44.9	3.804	2016
1981	32.96	0.0303	-3.495	0.9181	37.567	0.54164	-0.61315	0.29337	40.3	3.696	1624
1982	34.34	0.0291	-3.536	0.8468	35.885	0.54391	-0.60897	0.29584	35.1	3.558	1232
1983	34.45	0.0290	-3.540	0.8410	35.030	0.55469	-0.58935	0.30768	32.9	3.493	1082
1984	35.03	0.0285	-3.556	0.8123	35.232	0.56612	-0.56895	0.32049	32.0	3.466	1024
1985	35.53	0.0281	-3.570	0.7896	34.540	0.57045	-0.56133	0.32541	30.0	3.401	900
1986	33.98	0.0294	-3.526	0.8644	33.870	0.60593	-0.50099	0.36715	32.5	3.481	1056
1987	42.89	0.0233	-3.759	0.5429	34.998	0.59116	-0.52567	0.34947	32.7	3.487	1069
1988	42.20	0.0237	-3.742	0.5617	35.418	0.60705	-0.49914	0.36851	34.6	3.544	1197
1989	44.00	0.0227	-3.784	0.5153	36.000	0.60709	-0.49908	0.36856	36.9	3.608	1362
1990	45.17	0.0221	-3.810	0.4884	36.382	0.60790	-0.49774	0.36954	38.3	3.645	1467
1991	45.46	0.0220	-3.817	0.4840					38.7	3.656	1498
1992	45.23	0.0221	-3.812	0.4884					40.5	3.701	1640
1993	45.31	0.0221	-3.814	0.4884					41.7	3.731	1739
1994	44.86	0.0223	-3.804	0.4973					41.8	3.733	1747
1995	43.85	0.0228	-3.781	0.5198					41.8	3.733	1747
1996	42.95	0.0233	-3.760	0.5429					41.8	3.733	1747
1997	41.89	0.0239	-3.735	0.5712					42.6	3.752	1815
1998	37.09	0.0270	-3.613	0.7290					36.4	3.595	1325

Exhibit II
WORLD TABLE4

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs PRICE/PRICE RATIO

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.293105851
R Square	0.08591104
Adjusted R Square	0.050753772
Standard Error	11.75154226
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	337.4610032	337.4610032	2.443621063	0.130094705
Residual	26	3590.567383	138.0987455		
Total	27	3928.028386			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	10.01690768	9.95675594	1.006041299	0.323667383	-10.44951068	30.48332604	-10.44951068	30.48332604
X Variable 1	14.88009055	9.518941197	1.563208579	0.130094705	-4.686386131	34.44656722	-4.686386131	34.44656722

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN PRICE/PRICE RATIO

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.283183884
R Square	0.080193112
Adjusted R Square	0.044815924
Standard Error	11.78823985
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	315.00082	315.00082	2.266802888	0.14422567
Residual	26	3613.027566	138.9625987		
Total	27	3928.028386			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	25.29726855	2.228922137	11.34955239	1.4266E-11	20.71565048	29.87888662	20.71565048	29.87888662
X Variable 1	14.15505351	9.401662068	1.505590544	0.14422567	-5.170352304	33.48045933	-5.170352304	33.48045933

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ PRICE/PRICE RATIO

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.295798039
R Square	0.08749648
Adjusted R Square	0.052400191
Standard Error	11.74134662
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	343.6886569	343.6886569	2.49304077	0.126441186
Residual	26	3584.339729	137.8592203		
Total	27	3928.028386			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	17.56965699	5.311484526	3.307861842	0.002753884	6.651737027	28.48757695	6.651737027	28.48757695
X Variable 1	6.964266387	4.410732141	1.578936595	0.126441186	-2.102129316	16.03066209	-2.102129316	16.03066209

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs POP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.16020801
R Square	**0.025666606**
Adjusted R Square	-0.010419816
Standard Error	12.0970975
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	104.0847223	104.0847223	0.711253843	0.406437703
Residual	27	3951.173733	146.3397679		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	48.05868688	27.67772129	1.736367181	0.093898207	-8.731268244	104.848642	-8.731268244	104.848642
X Variable 1	-0.098350301	0.116617408	-0.843358668	**0.406437703**	-0.337629297	0.140928694	-0.337629297	0.140928694

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN POP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.135498997
R Square	0.018359978
Adjusted R Square	-0.01799706
Standard Error	12.14237148
Observations	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	74.45445642	74.45445642	0.504991033	0.483409012
Residual	27	3980.803999	147.4371851		
Total	28	4055.258455			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	132.2111398	151.175806	0.87455224	0.389530772	-177.9757846	442.3980642	-177.9757846	442.3980642
X Variable 1	-19.66326263	27.67029227	-0.710627211	0.483409012	-76.43797469	37.11144944	-76.43797469	37.11144944

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ POP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.184010665
R Square	0.033859925
Adjusted R Square	-0.001923041
Standard Error	12.04612695
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	137.310746	137.310746	0.946258199	0.339308393
Residual	27	3917.947709	145.1091744		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	38.18149916	13.94358006	2.738285218	0.010799467	9.571655248	66.79134308	9.571655248	66.79134308
X Variable 1	-0.000237675	0.000244331	-0.972758037	0.339308393	-0.000739002	0.000263651	-0.000739002	0.000263651

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs POP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.048825957
R Square	0.002383974
Adjusted R Square	-0.034564768
Standard Error	12.24078009
Observations	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	9.667630945	9.667630945	0.064521116	0.801412235
Residual	27	4045.590824	149.8366972		
Total	28	4055.258455			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	22.04996034	11.03730126	1.997767372	0.055908074	-0.596696047	44.69661672	-0.596696047	44.69661672
X Variable 1	287.6397332	1132.394996	0.254010071	0.801412235	-2035.841319	2611.120786	-2035.841319	2611.120786

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN POP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.250991118
R Square	0.062996541
Adjusted R Square	0.026957947
Standard Error	11.89792513
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	247.452202	247.452202	1.748029909	0.197638873
Residual	26	3680.576184	141.5606225		
Total	27	3928.028386			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-132.5562918	119.3328108	-1.110811779	0.276816806	-377.848558	112.7359745	-377.848558	112.7359745
X Variable 1	-34.13451221	25.81780234	-1.322130821	0.197638873	-87.20379973	18.93477531	-87.20379973	18.93477531

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ POP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.255405997
R Square	0.065232223
Adjusted R Square	0.029279617
Standard Error	11.88372248
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	256.2340249	256.2340249	1.814394814	0.189605911
Residual	26	3671.794361	141.22286		
Total	27	3928.028386			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	41.33636687	12.19604466	3.389325638	0.002244373	16.2670216	66.40571214	16.2670216	66.40571214
X Variable 1	-164.5143266	122.1343502	-1.346994734	0.189605911	-415.5652434	86.5365902	-415.5652434	86.5365902

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs GDP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.221636965
R Square	**0.049122944**
Adjusted R Square	0.013905276
Standard Error	11.95059617
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	199.2062357	199.2062357	1.394838051	0.247889072
Residual	27	3856.05222	142.8167489		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	29.55406794	4.601395227	6.422849262	6.99848E-07	20.11279112	38.99534476	20.11279112	38.99534476
X Variable 1	-1.189433054	1.007112787	-1.181032621	**0.247889072**	-3.255856419	0.876990311	-3.255856419	0.876990311

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN GDP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.03539524
R Square	**0.001252823**
Adjusted R Square	-0.035737813
Standard Error	12.24771775
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.080521024	5.080521024	0.033868652	0.855361704
Residual	27	4050.177934	150.0065902		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	25.58270471	4.854383435	5.270021425	1.47533E-05	15.62233931	35.54307011	15.62233931	35.54307011
X Variable 1	-0.655248977	3.560470523	-0.184034378	**0.855361704**	-7.960726155	6.650228202	-7.960726155	6.650228202

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ GDP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.338087837
R Square	0.114303386
Adjusted R Square	0.081499808
Standard Error	11.53373263
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	463.5297719	463.5297719	3.484479186	0.072842497
Residual	27	3591.728683	133.0269883		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	29.0553714	3.130489573	9.281414527	6.8582E-10	22.63214167	35.47860113	22.63214167	35.47860113
X Variable 1	-0.2041655	0.10937383	-1.866675973	**0.072842497**	-0.42858191	0.020250911	-0.42858191	0.020250911

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs GDP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.244745817
R Square	**0.059900515**
Adjusted R Square	0.023742842
Standard Error	11.91756535
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	235.2909228	235.2909228	1.65664742	0.209397712
Residual	26	3692.737463	142.028364		
Total	27	3928.028386			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	17.13128681	6.653335147	2.574842004	0.016071192	3.455151584	30.80742203	3.455151584	30.80742203
X Variable 1	103.1612498	80.14963532	1.287108162	**0.209397712**	-61.58879307	267.9112927	-61.58879307	267.9112927

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN GDP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.219146288
R Square	0.048025096
Adjusted R Square	0.011410676
Standard Error	11.992601
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	188.6439385	188.6439385	1.311644328	0.262530196
Residual	26	3739.384447	143.8224787		
Total	27	3928.028386			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	42.94395707	15.66739235	2.74097668	0.010929599	10.73914976	75.14876438	10.73914976	75.14876438
X Variable 1	6.778624969	5.918798624	1.145270417	0.262530196	-5.387647816	18.94489775	-5.387647816	18.94489775

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ GDP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.139191314
R Square	0.019374222
Adjusted R Square	-0.018342154
Standard Error	12.17172937
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	76.102494	76.102494	0.513681961	0.479938527
Residual	26	3851.925892	148.1509958		
Total	27	3928.028386			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	22.88505987	3.953123436	5.789108344	4.24871E-06	14.75929294	31.01082679	14.75929294	31.01082679
X Variable 1	0.354174803	0.494163317	0.716716095	0.479938527	-0.661593108	1.369942714	-0.661593108	1.369942714

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs 1/USEW

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.675616348
R Square	**0.45645745**
Adjusted R Square	0.434715748
Standard Error	9.085915314
Observations	27

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1733.181839	1733.181839	20.99455919	0.000110113
Residual	25	2063.846427	82.55385709		
Total	26	3797.028267			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	39.88086835	3.57268688	11.16271022	3.33076E-11	32.52278714	47.23894956	32.52278714	47.23894956
X Variable 1	-86.36970499	18.84985683	-4.581982016	**0.000110113**	-125.1916846	-47.54772534	-125.1916846	-47.54772534

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN 1/USEW

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.790265102
R Square	**0.624518931**
Adjusted R Square	0.609499689
Standard Error	7.551720946
Observations	27

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2371.316036	2371.316036	41.58125293	9.41863E-07
Residual	25	1425.712231	57.02848924		
Total	26	3797.028267			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-7.225881499	5.294807309	-1.364710947	0.184502204	-18.13073364	3.678970643	-18.13073364	3.678970643
X Variable 1	-16.79102912	2.603925347	-6.44835273	**9.41863E-07**	-22.15391001	-11.42814824	-22.15391001	-11.42814824

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ 1/USEW

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.578862414
R Square	0.335081695
Adjusted R Square	0.308484963
Standard Error	10.04930565
Observations	27

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1272.314667	1272.314667	12.59860392	0.001559269
Residual	25	2524.7136	100.988544		
Total	26	3797.028267			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	32.12361429	2.666931307	12.04516	6.62696E-12	26.63097029	37.61625828	26.63097029	37.61625828
X Variable 1	-181.441724	51.11824703	-3.549451214	0.001559269	-286.7216507	-76.16179725	-286.7216507	-76.16179725

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs 1/PROD

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.345785417
R Square	0.119567554
Adjusted R Square	0.086958945
Standard Error	11.49940597
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	484.8773355	484.8773355	3.666748064	0.066158837
Residual	27	3570.38112	132.2363378		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	56.03974407	16.45679355	3.40526506	0.002082187	22.27321548	89.80627266	22.27321548	89.80627266
X Variable 1	-91.12730452	47.58915447	-1.91487547	0.066158837	-188.7721185	6.51750948	-188.7721185	6.51750948

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN 1/PROD

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.327109152
R Square	**0.107000397**
Adjusted R Square	0.073926338
Standard Error	11.58118555
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	433.9142666	433.9142666	3.235175832	0.083262002
Residual	27	3621.344189	134.1238588		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	***P-value***	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-8.307634306	18.52842643	-0.448372361	0.657462095	-46.32479961	29.709531	-46.32479961	29.709531
X Variable 1	-30.69187614	17.06375049	-1.798659454	**0.083262002**	-65.70377666	4.320024386	-65.70377666	4.320024386

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ 1/PROD

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.361356709
R Square	0.130578671
Adjusted R Square	0.098377881
Standard Error	11.42727114
Observations	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	529.5302603	529.5302603	4.055138751	0.05410193
Residual	27	3525.728195	130.5825257		
Total	28	4055.258455			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	40.59146084	8.127038503	4.99461899	3.08992E-05	23.9161664	57.26675528	23.9161664	57.26675528
X Variable 1	-132.1071651	65.6029719	-2.013737508	0.05410193	-266.7132547	2.498924411	-266.7132547	2.498924411

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs OEUR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.065222329
R Square	**0.004253952**
Adjusted R Square	-0.032625531
Standard Error	12.22930236
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	17.25087556	17.25087556	0.115347391	0.736764244
Residual	27	4038.00758	149.5558363		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	12.60774131	35.95133296	0.35068912	0.728543035	-61.15825136	86.37373398	-61.15825136	86.37373398
X Variable 1	28.11564181	82.78356279	0.339628313	**0.736764244**	-141.7420848	197.9733684	-141.7420848	197.9733684

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN OEUR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.076407326
R Square	**0.005838079**
Adjusted R Square	-0.030982732
Standard Error	12.21957072
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	23.67492094	23.67492094	0.158553794	0.693622739
Residual	27	4031.583534	149.3179087		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	36.90023404	30.4892422	1.210270619	0.23666421	-25.65848162	99.45894971	-25.65848162	99.45894971
X Variable 1	14.44664392	36.2809499	0.398188139	**0.693622739**	-59.99566638	88.88895422	-59.99566638	88.88895422

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ OEUR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.065534044
R Square	0.004294711
Adjusted R Square	-0.032583263
Standard Error	12.22905207
Observations	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	17.41616295	17.41616295	0.116457347	0.735550558
Residual	27	4037.842292	149.5497145		
Total	28	4055.258455			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	18.66377206	18.10495608	1.03086536	0.311750376	-18.48450444	55.81204856	-18.48450444	55.81204856
X Variable 1	32.54913851	95.37972215	0.341258475	0.735550558	-163.153755	228.252032	-163.153755	228.252032

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs 1/USPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.075840465
R Square	**0.005751776**
Adjusted R Square	-0.03248854
Standard Error	12.15326917
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	22.21604416	22.21604416	0.150411311	0.701299677
Residual	26	3840.250742	147.7019516		
Total	27	3862.466786			

	Coefficients	*Standard Error*	*t Stat*	***P-value***	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	31.00029943	14.92547192	2.077006315	0.047820604	0.320532409	61.68006646	0.320532409	61.68006646
X Variable 1	-159.2739701	410.6809493	-0.387828971	**0.701299677**	-1003.441305	684.8933644	-1003.441305	684.8933644

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN 1/USPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.018745413
R Square	0.000351391
Adjusted R Square	-0.038096633
Standard Error	12.18623049
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1.357234167	1.357234167	0.009139365	0.924571283
Residual	26	3861.109552	148.5042135		
Total	27	3862.466786			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	20.66862374	48.29854937	0.427934669	0.672222613	-78.61053138	119.9477789	-78.61053138	119.9477789
X Variable 1	-1.381150464	14.44717687	-0.095600025	0.924571283	-31.07776729	28.31546636	-31.07776729	28.31546636

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ 1/USPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.127992944
R Square	0.016382194
Adjusted R Square	-0.02144926
Standard Error	12.08812371
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	63.27567917	63.27567917	0.433031035	0.51629016
Residual	26	3799.191107	146.1227349		
Total	27	3862.466786			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	30.19800297	7.813897542	3.86465305	0.000664758	14.13629602	46.25970992	14.13629602	46.25970992
X Variable 1	-3.723344938	5.658140928	-0.658050937	0.51629016	-15.3538278	7.907137928	-15.3538278	7.907137928

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs 1/USRPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.402096715
R Square	0.161681768
Adjusted R Square	0.12943876
Standard Error	11.15963937
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	624.4904605	624.4904605	5.014475197	0.033909243
Residual	26	3237.976325	124.537551		
Total	27	3862.466786			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-39.57536654	29.03931054	-1.36282046	0.18462707	-99.26656336	20.11583027	-99.26656336	20.11583027
X Variable 1	616.5104135	275.3136048	2.239302391	0.033909243	50.59482308	1182.426004	50.59482308	1182.426004

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN 1/USRPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.400206305
R Square	**0.160165086**
Adjusted R Square	0.127863744
Standard Error	11.1697298
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	618.6323264	618.6323264	4.958465263	0.03483701
Residual	26	3243.834459	124.7628638		
Total	27	3862.466786			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	167.0845482	63.71662957	2.622306756	0.014409204	36.11305457	298.0560419	36.11305457	298.0560419
X Variable 1	62.89314837	28.24422731	2.22676116	**0.03483701**	4.836269614	120.9500271	4.836269614	120.9500271

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ 1/USRPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.403727567
R Square	**0.162995948**
Adjusted R Square	0.130803484
Standard Error	11.15088881
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	629.5664352	629.5664352	5.063171004	0.03312492
Residual	26	3232.900351	124.3423212		
Total	27	3862.466786			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-8.146854418	15.00443259	-0.542963179	0.591779919	-38.98892754	22.6952187	-38.98892754	22.6952187
X Variable 1	3.004599884	1.335289237	2.250149107	**0.03312492**	0.25987175	5.749328018	0.25987175	5.749328018

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs PRCR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.460135769
R Square	**0.211724926**
Adjusted R Square	0.170236764
Standard Error	11.71538217
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	700.4235145	700.4235145	5.103261193	0.035828293
Residual	19	2607.753409	137.2501794		
Total	20	3308.176924			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	67.7430241	17.86882571	3.791129042	0.001234516	30.34313044	105.1429178	30.34313044	105.1429178
X Variable 1	-114.3794828	50.63190058	-2.259039883	**0.035828293**	-220.3533015	-8.405664006	-220.3533015	-8.405664006

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs LN PRCR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.448822655
R Square	0.201441776
Adjusted R Square	0.159412395
Standard Error	11.79154892
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	666.4050332	666.4050332	4.79287999	0.041263816
Residual	19	2641.771891	139.0406258		
Total	20	3308.176924			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-14.91172188	19.6749072	-0.757905576	0.457805619	-56.0917887	26.26834495	-56.0917887	26.26834495
X Variable 1	-40.3771346	18.44324002	-2.189264714	0.041263816	-78.9792916	-1.774977599	-78.9792916	-1.774977599

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SQ PRCR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.47648423
R Square	0.227037221
Adjusted R Square	0.186354969
Standard Error	11.60103813
Observations	21

ANOVA

	df	SS	MS	F	Significance F
Regression	1	751.0792953	751.0792953	5.58074375	0.028981797
Residual	19	2557.097629	134.5840857		
Total	20	3308.176924			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	47.70343308	8.800629626	5.420456843	3.13561E-05	29.28349786	66.12336831	29.28349786	66.12336831
X Variable 1	-159.9013747	67.68713882	-2.362359784	0.028981797	-301.5722284	-18.23052092	-301.5722284	-18.23052092

Exhibit III
Individual Regression Results
U.S. Market Data

PRICE vs SPECIAL EVENTS

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.062210473
R Square	0.003870143
Adjusted R Square	-0.033023555
Standard Error	12.23165902
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	15.69442999	15.69442999	0.104899838	0.748522636
Residual	27	4039.564025	149.6134824		
Total	28	4055.258455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	25.16594182	2.545935905	9.884750739	1.81967E-10	19.94211633	30.3897673	19.94211633	30.3897673
X Variable 1	-0.308637505	0.952930642	-0.323882444	0.748522636	-2.263888367	1.646613356	-2.263888367	1.646613356

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs PRICE/PRICE RATIO

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.109601689
R Square	**0.01201253**
Adjusted R Square	-0.025986988
Standard Error	15.5503792
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	76.44311437	76.44311437	0.316123225	0.578762515
Residual	26	6287.171628	241.8142934		
Total	27	6363.614743			

	Coefficients	*Standard Error*	*t Stat*	***P-value***	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	26.60115175	6.076338466	4.377825873	0.000173591	14.11105097	39.09125253	14.11105097	39.09125253
X Variable 1	2.653811441	4.719998491	0.562248366	**0.578762515**	-7.048290767	12.35591365	-7.048290767	12.35591365

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.163589679
R Square	**0.026761583**
Adjusted R Square	-0.010670664
Standard Error	15.43387176
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	170.3004053	170.3004053	0.714933926	0.405525168
Residual	26	6193.314338	238.2043976		
Total	27	6363.614743			

	Coefficients	*Standard Error*	*t Stat*	***P-value***	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	29.32750551	2.933381842	9.997847909	2.12959E-10	23.29784883	35.3571622	23.29784883	35.3571622
X Variable 1	6.919331082	8.183350604	0.845537655	**0.405525168**	-9.901798014	23.74046018	-9.901798014	23.74046018

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN PRICE/PRICE RATIO

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ PRICE/PRICE RATIO

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.071208282
R Square	0.005070619
Adjusted R Square	-0.033195895
Standard Error	15.6049145
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	32.26746852	32.26746852	0.132508003	0.718789289
Residual	26	6331.347274	243.5133567		
Total	27	6363.614743			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	28.99696968	3.37101969	8.60183931	4.42073E-09	22.06773493	35.92620443	22.06773493	35.92620443
X Variable 1	0.358691951	0.985372818	0.364016487	0.718789289	-1.666772212	2.384156115	-1.666772212	2.384156115

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs POP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.079290554
R Square	0.006286992
Adjusted R Square	-0.030517194
Standard Error	15.94640545
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	43.43814731	43.43814731	0.170822742	0.682645909
Residual	27	6865.771866	254.2878469		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	37.50763199	21.34302116	1.757372197	0.090189577	-6.284600802	81.29986478	-6.284600802	81.29986478
X Variable 1	-1.831903705	4.432306619	-0.41330708	0.682645909	-10.92623959	7.262432182	-10.92623959	7.262432182

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN POP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.031468949
R Square	0.000990295
Adjusted R Square	-0.036010065
Standard Error	15.9888478
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	6.842154369	6.842154369	0.026764463	0.871265699
Residual	27	6902.367859	255.6432541		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	34.10053949	32.70756136	1.042588871	0.306384552	-33.00978809	101.2108671	-33.00978809	101.2108671
X Variable 1	-3.433187042	20.98544578	-0.163598481	0.871265699	-46.49173624	39.62536216	-46.49173624	39.62536216

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ POP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.124041325
R Square	0.01538625
Adjusted R Square	-0.021080926
Standard Error	15.87322831
Observations	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	106.3068344	106.3068344	0.421920532	0.521468442
Residual	27	6802.903179	251.959377		
Total	28	6909.210014			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	35.6993705	11.06505608	3.226316273	0.00327598	12.99576597	58.40297503	12.99576597	58.40297503
X Variable 1	-0.298767664	0.459958089	-0.649554103	0.521468442	-1.242523076	0.644987748	-1.242523076	0.644987748

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs POP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.046959494
R Square	**0.002205194**
Adjusted R Square	-0.036171529
Standard Error	15.62736965
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	14.03300574	14.03300574	0.057461761	0.812433431
Residual	26	6349.581737	244.2146822		
Total	27	6363.614743			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	23.5224988	25.48927522	0.922839061	0.364576326	-28.87149112	75.91648873	-28.87149112	75.91648873
X Variable 1	356.5464404	1487.396101	0.239711829	**0.812433431**	-2700.842036	3413.934917	-2700.842036	3413.934917

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN POP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.096085102
R Square	0.009232347
Adjusted R Square	-0.028874101
Standard Error	15.57224311
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	58.75109805	58.75109805	0.242277809	0.626696423
Residual	26	6304.863645	242.4947556		
Total	27	6363.614743			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	79.53398686	101.5071329	0.783531015	0.440394994	-129.1170498	288.1850235	-129.1170498	288.1850235
X Variable 1	12.24019096	24.86745694	0.492217238	0.626696423	-38.87563233	63.35601425	-38.87563233	63.35601425

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ POP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.004093096
R Square	1.67534E-05
Adjusted R Square	-0.038444141
Standard Error	15.64449784
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.106612392	0.106612392	0.000435597	0.983507949
Residual	26	6363.50813	244.7503127		
Total	27	6363.614743			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	29.85878244	13.14661573	2.27121436	0.031648467	2.835509077	56.88205581	2.835509077	56.88205581
X Variable 1	-0.910351139	43.61809792	-0.02087095	0.983507949	-90.56869423	88.74799195	-90.56869423	88.74799195

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs GDP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.207079696
R Square	**0.042882**
Adjusted R Square	0.007433186
Standard Error	15.65002576
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	296.2807459	296.2807459	1.209687843	0.281104085
Residual	27	6612.929268	244.9233062		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	33.78448754	5.405345908	6.250198991	1.09722E-06	22.69364128	44.8753338	22.69364128	44.8753338
X Variable 1	-0.364331256	0.331252964	-1.099858101	**0.281104085**	-1.044005742	0.315343229	-1.044005742	0.315343229

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN GDP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.036704022
R Square	**0.001347185**
Adjusted R Square	-0.035639956
Standard Error	15.98599159
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	9.307985555	9.307985555	0.036423069	0.850072277
Residual	27	6899.902028	255.551927		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	***P-value***	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	26.97798359	9.856426784	2.737095722	0.010829931	6.754279872	47.2016873	6.754279872	47.2016873
X Variable 1	0.755424798	3.958247686	0.190848289	**0.850072277**	-7.366223157	8.877072752	-7.366223157	8.877072752

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ GDP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.325410237
R Square	**0.105891822**
Adjusted R Square	0.072776705
Standard Error	15.12611327
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	731.6288393	731.6288393	3.197688238	0.084971189
Residual	27	6177.581174	228.7993028		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	33.51592583	3.863715062	8.674533525	2.7333E-09	25.58824267	41.44360899	25.58824267	41.44360899
X Variable 1	-0.017815609	0.009962827	-1.788208108	**0.084971189**	-0.038257628	0.002626411	-0.038257628	0.002626411

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs GDP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.190048648
R Square	**0.036118489**
Adjusted R Square	-0.000953877
Standard Error	15.35950044
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	229.8441463	229.8441463	0.974269857	0.332714751
Residual	26	6133.770597	235.9142537		
Total	27	6363.614743			

	Coefficients	*Standard Error*	*t Stat*	***P-value***	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	33.65452242	5.036887017	6.681611541	4.3449E-07	23.3010461	44.00799875	23.3010461	44.00799875
X Variable 1	-44.47135792	45.05476799	-0.987051091	**0.332714751**	-137.0828206	48.14010473	-137.0828206	48.14010473

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ GDP GR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.204366303
R Square	**0.041765586**
Adjusted R Square	0.004910416
Standard Error	15.31444096
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	265.7800965	265.7800965	1.13323547	0.29687323
Residual	26	6097.834646	234.5321018		
Total	27	6363.614743			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	32.80968383	4.185165753	7.839518377	2.58106E-08	24.20694678	41.41242088	24.20694678	41.41242088
X Variable 1	-0.261481255	0.245629476	-1.06453533	**0.29687323**	-0.766380205	0.243417694	-0.766380205	0.243417694

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs 1/PROD

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.037311735
R Square	0.001392166
Adjusted R Square	-0.03559331
Standard Error	15.98563157
Observations	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	9.618764117	9.618764117	0.037640872	0.84761836
Residual	27	6899.59125	255.5404167		
Total	28	6909.210014			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	22.75144324	31.17202976	0.729867237	0.471756705	-41.20823585	86.71112232	-41.20823585	86.71112232
X Variable 1	126.3328048	651.1578794	0.194012556	0.84761836	-1209.731908	1462.397518	-1209.731908	1462.397518

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN 1/PROD

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.072925286
R Square	0.005318097
Adjusted R Square	-0.031521973
Standard Error	15.95417763
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	36.7438514	36.7438514	0.144356329	0.70696043
Residual	27	6872.466162	254.5357838		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	64.70503591	94.62204021	0.68382626	0.499912174	-129.4432237	258.8532955	-129.4432237	258.8532955
X Variable 1	11.78786403	31.02538668	0.379942534	0.70696043	-51.8709285	75.44665657	-51.8709285	75.44665657

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.00157734
R Square	2.488E-06
Adjusted R Square	-0.037034457
Standard Error	15.99675062
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.017190133	0.017190133	6.71762E-05	0.993520783
Residual	27	6909.192824	255.8960305		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	28.89748489	15.62884864	1.848983604	0.075438366	-3.170242213	60.96521199	-3.170242213	60.96521199
X Variable 1	-0.05494731	6.704070753	-0.008196111	0.993520783	-13.81055505	13.70066043	-13.81055505	13.70066043

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ 1/PROD

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs OEUR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.23771593
R Square	**0.056508863**
Adjusted R Square	0.013622902
Standard Error	14.62710184
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	281.9148787	281.9148787	1.317654128	0.263343016
Residual	22	4706.946384	213.9521084		
Total	23	4988.861263			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1.779671038	29.79427339	-0.059731983	0.952908382	-63.56927852	60.00993644	-63.56927852	60.00993644
X Variable 1	82.89303802	72.2133252	1.147891165	**0.263343016**	-66.86839298	232.654469	-66.86839298	232.654469

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN OEUR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.261576669
R Square	0.068422354
Adjusted R Square	0.026077915
Standard Error	14.53446004
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	341.3496299	341.3496299	1.615852192	0.216947473
Residual	22	4647.511633	211.2505288		
Total	23	4988.861263			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	66.31673127	26.96438012	2.459419834	0.022248509	10.39596953	122.237493	10.39596953	122.237493
X Variable 1	38.04661044	29.93058159	1.271161749	0.216947473	-24.02568325	100.1189041	-24.02568325	100.1189041

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ OEUR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.21486879
R Square	0.046168597
Adjusted R Square	0.002812624
Standard Error	14.70703687
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	230.3287252	230.3287252	1.064872819	0.313318054
Residual	22	4758.532537	216.2969335		
Total	23	4988.861263			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	17.05461156	15.02697394	1.134933196	0.268617837	-14.10945843	48.21868154	-14.10945843	48.21868154
X Variable 1	89.25740003	86.49586802	1.031926751	0.313318054	-90.12424367	268.6390437	-90.12424367	268.6390437

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs 1/PR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.335218753
R Square	0.112371612
Adjusted R Square	0.079496487
Standard Error	15.07120254
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	776.3990687	776.3990687	3.418134856	0.07546276
Residual	27	6132.810945	227.1411461		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.594494797	14.43282726	0.179763448	0.858680614	-27.01920078	32.20819037	-27.01920078	32.20819037
X Variable 1	19.80360863	10.71148634	1.848819855	0.07546276	-2.174531208	41.78174846	-2.174531208	41.78174846

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN 1/PR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.355132071
R Square	0.126118788
Adjusted R Square	0.093752817
Standard Error	14.95403925
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	871.3811899	871.3811899	3.896647754	0.058695062
Residual	27	6037.828824	223.6232898		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	21.91493159	4.44711165	4.92790227	3.69676E-05	12.79021831	31.03964488	12.79021831	31.03964488
X Variable 1	26.54691121	13.44833203	1.973992846	0.058695062	-1.046768361	54.14059079	-1.046768361	54.14059079

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ 1/PR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.312544915
R Square	0.097684324
Adjusted R Square	0.064265225
Standard Error	15.19538003
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	674.9215071	674.9215071	2.923008884	0.098795435
Residual	27	6234.288507	230.8995743		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	15.77333787	8.109552166	1.945031927	0.062254018	-0.866077591	32.41275334	-0.866077591	32.41275334
X Variable 1	7.159550576	4.187653058	1.709680931	0.098795435	-1.432798004	15.75189916	-1.432798004	15.75189916

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs 1/RPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.401949894
R Square	0.161563717
Adjusted R Square	0.130510521
Standard Error	14.64762952
Observations	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1116.277651	1116.277651	5.202804849	0.030660614
Residual	27	5792.932362	214.5530505		
Total	28	6909.210014			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-9.88488788	17.16436175	-0.575896035	0.569455034	-45.10322552	25.33344976	-45.10322552	25.33344976
X Variable 1	1398.156334	612.9668194	2.280965771	0.030660614	140.4531507	2655.859517	140.4531507	2655.859517

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN 1/RPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.414562229
R Square	0.171861842
Adjusted R Square	0.141190058
Standard Error	14.55739656
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1187.429561	1187.429561	5.603255559	0.025352979
Residual	27	5721.780453	211.9177946		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	172.6568524	60.844978	2.837651654	0.008520579	47.81335342	297.5003515	47.81335342	297.5003515
X Variable 1	39.95584419	16.87952012	2.367119676	0.025352979	5.321952906	74.58973548	5.321952906	74.58973548

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ 1/RPR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.389475382
R Square	0.151691073
Adjusted R Square	0.120272224
Standard Error	14.73361555
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1048.065481	1048.065481	4.828027668	0.036761488
Residual	27	5861.144533	217.0794272		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	9.931259311	9.000380441	1.103426614	0.279579762	-8.535983567	28.39850219	-8.535983567	28.39850219
X Variable 1	24.02740066	10.93507875	2.197277331	0.036761488	1.590487398	46.46431392	1.590487398	46.46431392

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs PRCR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.715484642
R Square	0.511918274
Adjusted R Square	0.486229762
Standard Error	12.28514167
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3007.613485	3007.613485	19.92790689	0.000266023
Residual	19	2867.569411	150.9247058		
Total	20	5875.182895			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	124.5977149	20.88071843	5.967118197	9.62903E-06	80.89385539	168.3015745	80.89385539	168.3015745
X Variable 1	-144.2242967	32.30781498	-4.464068423	0.000266023	-211.8453516	-76.60324177	-211.8453516	-76.60324177

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN PRCR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.735019737
R Square	**0.540254014**
Adjusted R Square	0.516056857
Standard Error	11.92320108
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3174.091141	3174.091141	22.32716885	0.000147318
Residual	19	2701.091754	142.1627239		
Total	20	5875.182895			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-12.79835819	9.863225101	-1.297583504	0.20996434	-33.44233199	7.845615616	-33.44233199	7.845615616
X Variable 1	-99.3064162	21.01650429	-4.725163368	**0.000147318**	-143.2944789	-55.31835352	-143.2944789	-55.31835352

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ PRCR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.69510146
R Square	0.48316604
Adjusted R Square	0.455964253
Standard Error	12.64181458
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2838.688854	2838.688854	17.76229016	0.000469491
Residual	19	3036.494041	159.8154759		
Total	20	5875.182895			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	75.25337806	10.59142504	7.105123037	9.31221E-07	53.08526379	97.42149233	53.08526379	97.42149233
X Variable 1	-103.1747826	24.48071412	-4.214533208	0.000469491	-154.4135221	-51.93604318	-154.4135221	-51.93604318

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs OPEC

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.417938587
R Square	0.174672663
Adjusted R Square	0.144104983
Standard Error	14.53267061
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1206.850109	1206.850109	5.714292591	0.024067228
Residual	27	5702.359904	211.198515		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	64.81236196	15.31648653	4.231542388	0.000239254	33.38554856	96.23917537	33.38554856	96.23917537
X Variable 1	-0.847808644	0.354663588	-2.390458657	0.024067228	-1.57551773	-0.120099559	-1.57551773	-0.120099559

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs LN OPEC

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.428229138
R Square	0.183380195
Adjusted R Square	0.153135017
Standard Error	14.4558046
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1267.012278	1267.012278	6.063121696	0.020473344
Residual	27	5642.197736	208.9702865		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	165.0537816	55.41160752	2.978686037	0.006053515	51.35863047	278.7489327	51.35863047	278.7489327
X Variable 1	-36.50266153	14.82437488	-2.462340695	0.020473344	-66.91974591	-6.085577143	-66.91974591	-6.085577143

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SQ OPEC

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.407757231
R Square	**0.166265959**
Adjusted R Square	0.135386921
Standard Error	14.60649726
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1148.766431	1148.766431	5.384427985	0.028114786
Residual	27	5760.443583	213.3497623		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*pper 95%*	*ower 95.0*	*pper 95.0%*
Intercept	46.67976469	8.180290073	5.706370345	4.60194E-06	29.89520712	63.46432	29.89521	63.46432
X Variable 1	-0.009602522	0.004138238	-2.320437025	**0.028114786**	-0.01809348	-0.00111	-0.01809	-0.00111

Exhibit IV
Individual Regression Results
World Market Data

PRICE vs SPECIAL EVENT

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.050696909
R Square	**0.002570177**
Adjusted R Square	-0.034371669
Standard Error	15.97620004
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	17.75788964	17.75788964	0.069573584	0.793961423
Residual	27	6891.452124	255.2389676		
Total	28	6909.210014			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	29.16794893	3.325336426	8.771427969	2.18473E-09	22.34492675	35.99097112	22.34492675	35.99097112
X Variable 1	-0.328300544	1.244656226	-0.263768049	**0.793961423**	-2.882122461	2.225521372	-2.882122461	2.225521372

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